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Research Article

Comparison of Success Rate of Weaning from Mechanical Ventilation Using Burn's Wean Assessment Program and Routine Method

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Abstract

Background and Objectives: Weaning decision for the patients undergoing mechanical ventilation (MV) is often made based on personal judgments and experiences, which results in longer MV length of stay and higher costs. Therefore, the present study aimed to evaluate the effect of Burn's wean assessment program on the success rate of weaning from ventilator in patients admitted to the Intensive care unit (ICU).
Methods: The present experimental study was carried out on 100 patients undergoing MV for more than 72 hours. The patients were selected by convenience sampling and randomly divided into two groups of 50 subjects. Burn's wean assessment program was applied to the intervention group, while weaning was assessed by a physician in the control group.
Results: 35 patients in the intervention group were male and 15 were female. In the control group, 36 were male and 14 were female. Chi-square test showed no statistically significant difference between the two groups ($P < 0.826$). In the intervention group, 46 patients had successful weaning (92%) and 4 patients had unsuccessful weaning (8%). In the control group, 35 patients had successful weaning (70%) and 15 patients had unsuccessful weaning (30%). Chi-square test showed a statistically significant difference between the two groups ($P < 0.005$).
Conclusions: Using Burn's scale for assessing patient readiness for weaning from mechanical ventilation is more useful.

Keywords: Burn's Wean Assessment Program, Mechanical Ventilation, Successful Weaning

1. Background

Mechanical ventilation as an oxygenation and ventilation support in patients who cannot have natural respiration due to any reason has been saving patients' lives (1). Moreover, it is an integral part of treatment for most patients in critical stages and those with multiple complications (2). Weaning covers the entire process of liberating the patient from mechanical support as well as from endotracheal tube (3). This process can take more than 56% - 90% of the time of mechanical ventilation. Therefore, determining the patient's readiness to separate and manage the process of weaning from mechanical ventilation is a very important issue (4). Mechanical ventilation is associated with many complications and weaning patients improperly from mechanical ventilation can lead to respiratory failure and re-intubation. Thus, weaning from ventilator support means should be done as soon as the patient is able to breathe voluntarily (5, 6). Patients who are weaned late from mechanical ventilation have higher mortality and experience pneumonia and more ventilator-induced lung injury (7). On the other hand, early weaning and unsuccessful extubation can lead to tracheal reintubation. Reintubation has been reported in range of 4% - 33% (8). Tracheal reintubation potentially leads to the airway trauma, aspiration, and acute lung injury. Statistics show that reintubation increases the risk of nosocomial pneumonia 8 times, and the mortality rate 6 - 12 times. Accordingly, cutting mechanical ventilation should be planned (9). The decision of weaning from mechanical ventilation is based on the subjective judgment of physicians and this will prolong the duration of mechanical ventilation and increase patient's costs (4). There are different tools to assess patients' readiness for weaning from mechanical ventilation. These tools check the patient's readiness for weaning from the device, leading to timely and successful weaning (10). This device systematically and comprehensively measures the criteria for weaning from mechanical ventilation. The use of this checklist is easy and its parameters assessment lasts 10 minutes (11). In a study carried out by Burn et al., by examining the effectiveness of this checklist for 5 years at ICU, it was found that the use of this device led to successful weaning from mechanical ventilation in 88% of cases in patients undergoing mechanical ventilation for more than 72 hours (12). In a study by Salman et al. it was found that the use of BWAP checklist in patients receiving mechanical ventilation for over 48 hours significantly reduced the duration of mechanical ventilation compared to a group weaned from the ventilator by medical judgment (13).

In another study by Suzanne et al., BWAP checklist was used for weaning patients admitted to 5 special sections and it was concluded that the patients who were qualified based on 20 BWAP checklist items would have a successful weaning, and among the sections under study, neurosurgical intensive care patients had a better weaning with BWAP checklist compared to other patients (14). According to studies carried out in Iran, in most ICUs, weaning from mechanical ventilation is performed on an experimental basis by evaluating some criteria merely under medical supervision and no tool is used to assess readiness. This can lead to failure of weaning patients, patient's reintubation, prolonged mechanical ventilation, and increased patient's length of stay in the intensive care unit (15, 16). Thus, this study aimed to evaluate the success rate of weaning from ventilator for patients in the intensive care unit by applying BWAP checklist.

2. Methods

This experimental study was conducted after obtaining the necessary approval from Zahedan University of Medical Sciences, Iran, and receiving the code of ethics (IR.ZAUMS.REC.1394.335) from the ethics committee of the university in 2015. The study was carried out on 100 mechanical ventilation-dependent patients admitted to the general ICU of Khatam-ol-Anbia hospital, Zahedan.

The sample size was determined according to previous studies using the sample size formula (6, 13). All patients were selected through simple available sampling based on purposive sampling method. They were randomly divided into two groups of 50 subjects. Informed written-consent forms were obtained from their first-degree relatives due to the lack of consciousness of the patients. Inclusion criteria were as follows:

Being connected to mechanical ventilation over 72 hours, the absence of active and uncontrolled respiratory infection, acute myocardial infarction and pleural effusion, consciousness level of 9 or higher based on Glasgow coma scale (GCS), and lack of obesity (BMI > 30).

Exclusion criteria included:

The patient's death, unplanned removal of endotracheal tube (self-extubation), and spontaneous breathing trial intolerance in 24 hours. In this study, the BWAP checklist was used to evaluate patients in the intervention group while weaning was assessed by a physician in the control group. Burn et al. developed this checklist including 26 phrases of which, 12 are used for the patient's general assessment, and 14 are used to measure the patient's respiratory function. There are some three-choice questions (Yes/No/Not Checked): "yes" is scored one while "No" and "Not Checked" will receive the score of zero. The total score is 26 and after receiving the score of 17 or higher, the process of weaning can begin (Table 1) (12, 14).

The use of this checklist is recommended to evaluate the readiness of all patients at ICU (17). Face validity method was used to assess the validity of checklist. In this case, the English version and the Persian translation were given to anesthesiology and critical care nursing faculty members to discuss the validity of the checklist and express their opinion. For the reliability of the instrument, three researchers (an MSc in critical care nursing, an anesthesiologist, and an expert in intensive care), two residents of anesthesiology, and two nurses were recruited for 10 patients with the same diagnosis as pilot study that showed a good reliability with Cronbach's alpha coefficient of 0.91. After beginning the study, the intervention group patients were assessed based on BWAP checklist and appropriate corrective treatments were made based on the results of the evaluation and the treatment outcome was followed up to complete the correction of abnormalities. This assessment was conducted only in the morning and afternoon shifts, and the assessment was stopped in night shifts due to the patient's need for rest and the impossibility of weaning process. In addition, after the patient received the score above 18 from the checklist, the process of weaning was performed as follows:

Initially, sedation was discontinued and if the patient needed more medication for pain relief, only Fentanyl would have injected with a minimum dose of 1 μg/kg/hour infusion and the injection of dexamethasone 0.5 - 2 mg/kg/day was conducted in four sessions of 6 hours. Using BWAP checklist, the patient was examined frequently. By obtaining score over 18 at any stage of the assessment, the process of weaning was initiated in the way that the patient was put on T-tube with 6 - 8 liters of oxygen for half an hour and was returned to spontaneous ventilation mode once more and spontaneous breathing exercise was carried out for four 30-min sessions. Some patients could not tolerate the spontaneous breathing trial exercise in 4 hours; therefore, it was continued for them up to 24 hours based on the patient's need. In case of tolerance and lack of arterial blood oxygen saturation, if the patient was intubated, after receiving pre-oxygenation with 100% oxygen and oral and tracheal suctioning, the patient's endotracheal tube was removed and in case of having tracheostomy, administration of oxygen with T-tube was stopped. In the following, the patient was reexamined

Table 1. Burn's Wean Assessment Checklist

Row		Yes	No	Not Checked
1	Checking the general condition			
	Is the hemodynamic status of patient constant? (Heart fixed-rate and rhythm and blood pressure, the use of vasopressor drugs or any oral agent applied to control rhythm, rate and blood pressure except low-dose of dopamine and dobutamine)			
2	The absence of factors that increase or decrease the metabolic demand (Seizure, temperature, sepsis, Bacteremia, hypo-or hyperthyroidism)			
3	Hematocrit is more than 25% (baseline). Consider a drop in hematocrit synonymous with bleeding and also blood transfusions			
4	There is a proper systemic hydration (weight is close to the base weight and absorption and excretion are suitable)			
5	Patient's nutrition is good (his/her Albumin is more than 2.5 and parenteral or gastrointestinal nutrition is maximal). If patient's albumin is low and there is edema, hydration score (No. 4) should be considered as 9.			
6	The electrolytes level is normal (calcium, magnesium, and phosphorus). Correct calcium level with albumin.			
7	Pain is controlled.			
8	Sufficient rest and sleep			
9	The level of anxiety and agitation of the patient is acceptable and appropriate.			
10	There is no intestinal problems (diarrhea, constipation and intestinal paralysis, i.e., the absence of bowel sounds in the past 3 days)			
11	There is enough muscle power (he/she can sit up in bed or hold himself/herself in a sitting position even if he/she needs help, this factor is considered as positive)			
12	A chest radiograph situation is appropriate (better than before)			
	Evaluation of respiratory function			
13	Breathing pattern is normal (spontaneous breathing less than or equal to 25, lack of dyspnea and not using accessory respiratory muscles)			
14	The absence of abnormal breathing sounds (crackles, rhonchi, and wheeze). The answer is "no" for each sound.			
15	Lung secretion is minimal (the amount of discharges and their concentration, and the number of suctions should be considered)			
16	Musculoskeletal disease or deformity of the chest does not exist			
17	There is no abdominal distention, obesity, and ascites. (If distention is even caused by ileus, "no" should be considered)			
18	Endotracheal tube $\geq$ 7.5, or track $\geq$ 6.5.			
19	Swallowing reflex and cough reflex			
20	The negative inspiratory pressure less than or equal to 20 cm water			
21	Expiratory positive pressure is more than or equal to 30 cm of water			
22	The current volume of spontaneous breathing is 5 cc/kg			
23	The vital capacity is more than 10 - 15 cc/kg			
24	pH is ranging from 7.30 - 7.45			
25	PCo2 is about 40 mm Hg or at the base of the first day of hospitalization, minute ventilation is less than 10 L/min			
26	Pao2 is more than 60 mm Hg with inspiratory oxygen less than or equal to 40% and end-expiratory positive airway pressure of at least 5 cm of water			
	Total score			

for respiratory failure (arterial oxygen desaturation, dyspnea, the use of accessory muscles of respiration, or apnea) to be re-intubated if needed or be connected to mechanical ventilation through a tracheostomy, classified as unsuccessful case of weaning. Tolerating weaning, lack of respiratory distress, and lack of drop in the level of arterial blood oxygen saturation for 48 hours were considered as successful cases. In the control group, no intervention was performed and weaning was assessed by a physician; however, post extubation was assessed for respiratory failure for 48 hours, as shown in diagram 1. The data were then analyzed in SPSS software. Independent Samples T Test was used to compare the data between the groups. Chi-square test was used to check the nominal data on weaning and logistic regression was used for the predictability of the results of weaning based on all variables (Figure 1).

3. Results

There were 50 patients in the intervention group, among whom 35 were male and 15 were female.

In the control group, 36 patients were male and 14 were female. Chi-square test showed no statistically significant difference between the two groups ($P < 0.826$). In the intervention group, 35 patients required mechanical ventilation due to trauma (70%), 10 patients due to stroke (20%), and 5 patients due to surgery (10%). In the control group, 36 patients required mechanical ventilation due to trauma (71%), 10 patients due to stroke (20%), and 4 patients due to surgery (%9). Chi-square showed no statistically significant difference between the two groups ($P < 0.939$). The chi-square test was also used to compare the number of patients with successful or unsuccessful weaning and those ventilated with endotracheal tube or tracheostomy. The results are shown in Table 2.

Independent t-test was used to compare the mean age, weight, days of hospitalization, and score of Glasgow Coma Scale between the two groups. The results are shown in Table 3.

Based on the reason for hospitalization, the number of successful weaning in the intervention group was 32 among patients hospitalized due to trauma (69.6%), 9 among patients hospitalized due to stroke (%19.6), 5 among patients hospitalized due to surgery (10.9%). Unsuccessful weaning was observed for 3 patients hospitalized due to trauma (%75) and 1 patient hospitalized due to stroke (%25). Chi-square showed no statistically significant difference between the two groups. However, since the number of unsuccessful weaning among surgical patients was zero, the test result is not reliable ($P < 0.777$). In the intervention group, the successful airway management was observed for 36 patients ventilated with endotracheal tube (78.2%) and 10 patients ventilated with tracheostomy (21.8%). The unsuccessful airway management was observed for 4 patients ventilated with endotracheal tube. Chi-square showed no significant difference between the two groups ($P < 0.826$).

Independent t-test was used to compare the mean age, weight, days of hospitalization, score of Glasgow Coma Scale, and score of Burn's scale between the two groups. The results are shown in Table 4.

In addition, chi-square showed no statistically significant gender difference in terms of successful or unsuccessful weaning in the intervention group. Since the number of women in the unsuccessful group was zero, Fisher's exact test result was reported ($P < 0.302$).

Based on the reason for hospitalization, successful weaning in the control group was observed for 26 patients hospitalized due to trauma (88.6%), 2 patients hospitalized due to stroke (5.7%), and 2 patients hospitalized due to surgery (5.7%), and unsuccessful weaning was observed for 5 patients hospitalized due to trauma (33.3%), 8 hospitalized patients due to stroke (53.3%), and 2 patients hospitalized due to surgery (13.3%). Chi-square test showed a statistically significant difference between the groups, implying that patients with trauma had more successful weaning ($P < 0.000$).

Independent t-test was used to compare the mean age, weight, days of hospitalization, and score of Glasgow Coma Scale. The results are shown in Table 5.

In addition, chi-square indicated no statistically significant gender difference in terms of successful or unsuccessful weaning in the control group ($P < 0.216$). In the control group, the airway successful management was observed for 29 patients ventilated with endotracheal tube (82.9%) and 6 patients ventilated with tracheostomy (17.1%) and unsuccessful weaning was observed for 5 patients ventilated with endotracheal tube (33.3%) and 10 patients ventilated with tracheostomy (66.7%). Chi-square showed a significant difference between the groups, implying that patients who were ventilated with endotracheal tube had more successful weaning ($P < 0.001$).

4. Discussion

The results showed that the use of this scale (BWAP) increases the chances of successful weaning from mechanical ventilation and its application is much more useful for patients with tracheotomy and long-term stay in intensive care unit. This is because all the patients in the intervention group with tracheotomy experienced successful weaning from mechanical ventilation. Based on the results of this study, patients in the control group undergoing endotracheal intubation experienced more successful weaning compared to those undergoing tracheostomy. Moreover, the failure rate of CVA patients in weaning process was higher compared to the others. This shows that patients undergoing mechanical ventilation for longer periods should be provided with a more comprehensive assessment in terms of nutrition and muscle strength that may not be provided with routine assessments. JUNG-RERN JIANG et al. used the modified BWAP checklist to wean patients hospitalized at ICU for a long time (more than 21 days). They reported that this is a very good predictor for weaning and extubation; this is in agreement with the results of our study because we also found Burn's

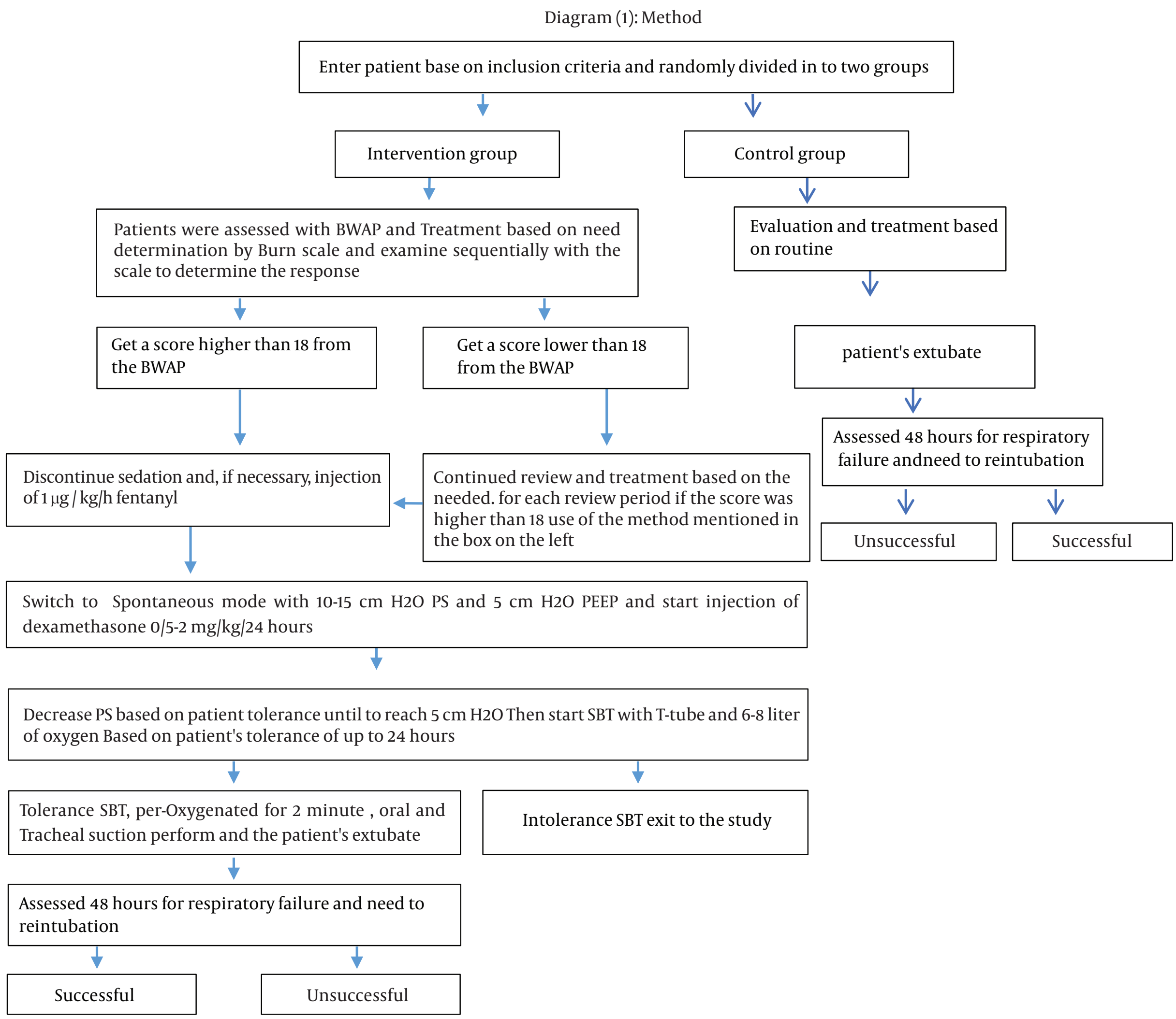

Figure 1. Method

Table 2. Comparison of Success Rate of Weaning and Ventilation with Endotracheal Tube or Tracheostomy Between the Groups

Patients Group	Number	Number of Ventilation with ETT	Number of Ventilation with Tracheostomy	P	Successful Weaning	Unsuccessful Weaning	P Value
Intervention	50	40	10	0.000	46	4	0.005
Control	50	34	16		35	15	

Table 3. Comparison of the Means in the Two Groups

Group	Number	Mean Age ± SD	P	Mean Weight ± SD	P Value	Mean Day of Hospitalization	P	Mean GCS ± SD	P Value
Intervention	50	39 ± 19	0.648	69.9 ± 15.8	0.029	20.2 ± 9.2	0.081	10.1 ± 0.8	0.148
Control	50	38 ± 20		72.6 ± 8.6		15.4 ± 10.1		9.8 ± 0.8	

Table 4. Intergroup Comparison of the Means

Intervention Group	Number	Age ± SD	P Value	Weight ± SD	P Value	Day of Hospitalization	P Value	GCS ± SD	P	Burn's Score	P Value
Successful weaning	46	37.8 ± 11.6	0.648	67.3 ± 16/2	0.540	9.8 ± 3.7	0.237	10 ± 0.8	0.082	22 ± 1.8	0.272
Unsuccessful weaning	4	38 ± 15.8		62.5 ± 11.9		14.7 ± 3.3		10.2 ± 0.9		22.7 ± 0.9	

Table 5. Intergroup Comparison of the Means

Control Group	Number	Mean Age ± SD	P Value	Mean Weight ± SD	P Value	Day of Hospitalization	P Value	GCS ± SD	P Value
Successful weaning	35	39.8 ± 10.6	0.748	72.6 ± 9.1	0.705	12.9 ± 8/8	0.118	9/8 ± 0/8	0.704
Unsuccessful weaning	15	38 ± 15.8		72.5 ± 7.6		21.2 ± 10.8		10 ± 0/7	

Wean scale as a good predictor of weaning and extubation. In addition, considering that it was highly successful in patients with prolonged length of stay, it is consistent with the results of this study, because patients with tracheostomy and prolonged length of stay had more successful weaning. However, the mentioned study was different from the current one because indices such as the resistance of airway (RAW), lung compliance (LCs) and rapid shallow breathing index (RSBI) had also been investigated. In the mentioned study, the patients with tracheostomy were less frequent than those with endotracheal intubation were. The patients' prolonged length of stay was likely due to Thai families' dissatisfaction with tracheostomy. In this study, the number of patients with endotracheal intubation was higher that may be due to the short duration of stay (18). In Salmani's study, the BWAP checklist was compared with the usual method of decision-making for weaning in terms of the length of stay and success rate. It was reported that in patients evaluated and weaned by the nurse using the checklist, the success rate was higher. Moreover, the length of stay in the ward was less in the group evaluated with the BWAP checklist, which is consistent with the results of the present study. Although this study confirmed that the use of this checklist could predict the success of weaning and extubation, the effect of applying this tool on the length of hospital stay was not assessed (13). Dubose et al. also reported that the daily use of checklist to assess the progress of trauma patients reduces the length of stay and ventilator-associated pneumonia in the intensive care unit (19). Burn et al. reported in their study that this checklist predicts the chance of success of weaning from mechanical ventilation up to 88% (12). In another study, Sadeghi-Nezhad et al. compared the success rate for patients in the normal group evaluated by a physician and for a group of patients evaluated by standard index of weaning from ventilator measured and reported as IWI = (C st, rs × Sao2)/(f/tv). The success rate in the group weaned based on RSBI was more than the group weaned according to the normal data such as level of consciousness, coughing, secretion removal, and the ability to move, and measurable indices such as ABG indices, Rapid Shallow Breathing Index (RSIB), lung compliance, ability to create spontaneous breathing volume, and positive end-expiratory pressure. Although in the mentioned study, the method of the present study was not used, it's results were consistent with the results of this study because it showed that weaning cannot be merely done according to objective judgment and patients must be weaned according to a determined standard method and the exact data (20). Moreover, Epstein et al used the Burn's checklist to investigate the success rate of weaning from ventilator in the elderly hospitalized at ICU for a long time due to different surgeries (12 days on average). The obtained results showed that the use of Burn's checklist could increase the success rate of weaning from ventilator in these patients, which is consistent with the results of the present study because the success rate of extubation and weaning from tracheostomy was more in the intervention group while in the control group, elderly patients and patients with tracheostomy had less successful rate of weaning and extubation (21). Blackwood et al. reported that daily screening based on weaning protocols might shorten the duration of mechanical ventilation and hospitalization in ICU and it could reduce costs and rates of weaning failure (22). The study of Yazdannik et al. showed that patients' assessment for weaning by a nurse using Burn's tool significantly lowered the length of MV (11).

4.1. Research Limitations

One of the limitations of this study was the inability of ventilators to measure negative inspiratory pressures and positive expiratory pressures for all patients; accordingly, negative inspiratory pressure was measured only for some of the patients.

4.2. Conclusions

Based on the results of this study, the BWAP checklist could be useful for weaning from mechanical ventilation especially for patients with tracheostomy and patients hospitalized for a long time in intensive care units.

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