Original Article

The Effect of Nursing Interventions Based on Burns Wean Assessment Program on Successful Weaning from Mechanical Ventilation: A Randomized Controlled Clinical Trial

Abstract

Background: The effective design and implementation of the nursing interventions to evaluate the patients' readiness for ventilator weaning will reduce their connection time to the ventilator and the complications of their connection to it. This study was conducted to examine the effect of nursing interventions based on the Burns Wean Assessment Program (BWAP) on successful weaning from Mechanical Ventilation (MV). **Materials and Methods:** In this clinical trial, 70 patients undergoing MV in the Intensive Care Units (ICUs) of Golestan Hospital (Ahvaz, Iran) in 2018 were randomly assigned to intervention and control groups. The nursing interventions designed based on BWAP were implemented on the patients in the intervention group, who were later weaned from the device according to this program. The recorded data included demographic information, BWAP score, vital signs, and laboratory values, which were analyzed using the Pearson correlation coefficient, Chi-Square, Fisher, and Mann-Whitney U tests. **Results:** There was a statistically significant and inverse correlation between the BWAP score and the MV duration such that a high BWAP score was associated with a shorter MV time ($p = 0.041$). Also, the mean number of re-intubation ($p = 0.001$) and the number of re-connection to the ventilator in the intervention group were significantly lower ($p = 0.005$). **Conclusions:** The results showed that nurses' assessment of patient's readiness for weaning from MV based on this tool and designed nursing care reduced the duration of MV, re-intubation, and re-connection.

Keywords: *Intensive care units, nursing care, ventilator weaning*

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Introduction

The progress in the treatment of patients with acute critical life events has increased the survival rates of the patients who need Mechanical Ventilation (MV).[1] More than 800,000 patients need MV in the Unites States each year, which is projected to significantly increase with population aging.[2] Moreover, the patients who need MV support for more than 3 weeks account for more than 50% of the total ICU costs.[3] Although MV is often a lifesaver, it can lead to physiological, psychological, and lethal complications for the patients.[4,5] Nurses can reduce quickly and properly the dangers of using MV through reducing the ventilation protection, which leads to timely weaning of MV.[6] One of the significant roles of nurses in ICU is the diagnosis of the patient's readiness for weaning. Effective weaning features involve interventions to provide better weaning preparation, frequent evaluation of weaning readiness, strategies for enhancing and promoting spontaneous breathing during weaning, and the use of Spontaneous Breathing Trials (SBT) to help determine the likelihood of weaning the patient from the ventilator.[7] ICU nurses are recommended to focus on the interventions assisting the patient in reaching this readiness point.[8] Through weaning tools and protocols, nurses can prepare the patients for weaning from MV effectively and safely. Previous studies have indicated that the use of standard weaning protocols can shorten the time of MV.[9,10] The established tools for assessing the patients' readiness for ventilator weaning such as Negative Inspiratory Force (NIF), Vital Capacity (VC), and Maximum Inspiratory Pressure (MIP) have not predicted weaning accurately. The Rapid Shallow Breathing Index (RSBI) is a good predictor of

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weaning success if the value is low; however, it is not much effective when the value is around 105.[10]

The BWAP has been used since 1990 as a comprehensive clinical weaning checklist. Early tests and individual factors of BWAP in the ICU have been reported in.[11,12] This tool systematically and comprehensively evaluates the criteria of the patient's weaning from the MV. The tool allows examining all the criteria related to lung function, gas changes, and physiological and psychological status. Burns *et al*. assessed the effectiveness of this checklist for 5 years in five Adult Intensive Care Units (AICUs) and found that using this tool provided successful weaning of the patient from MV in patients under ventilation for more than 3 days in 88% of the cases.[13] The application of BWAP yielded positive outcomes in the former survey. In this regard, the systematic management of weaning from the ventilator has been recommended.[14,15] Burns *et al*. (2010) also recommended analyzing BWAP clinical factors more precisely and revising them in future studies. In this way, BWAP can be used as an efficient and effective tool in deciding on patients' readiness for weaning.[13] In another study, Keykha *et al*. showed that assessment of the patient's readiness using the BWAP significantly increases the chances of successful weaning from MV.[16]

To the best of our knowledge, there are a limited number of studies about this issue in Iran. According to these studies, in most ICUs, the patients' weaning from the MV device is experimentally evaluated by some criteria and only with the opinion of the physician, without using any tool for assessment of the patient's readiness.[17,18] In previous studies, despite using a device for observation and completing the checklist, the role of nurses and nursing care in preparing patients for weaning from the MV device has not been considered.[17,19] An evidence-based review of the literature suggests that nurses and other health staff usually adhere to protocols more closely than physicians.[20,21] The present study aims to examine the effect of nursing interventions based on the BWAP score on successful weaning from MV.

Materials and Methods

This clinical trial (IRCT20181113041632N1) was conducted from September 2018 to January 2019 in two ICUs of Golestan hospital in Ahvaz, Iran. Considering the power of 80%, $\alpha = 0.05$, d = 39.48, and s = 1.55 and regrading 10% dropout, 35 patients in the intervention group and 35 in the control group (70 patients) were recruited. The intervention type [Figure 1] was assigned to patients randomly using permuted block randomization with a block size of 4 (using the table on random permutations). The first author, who collected outcomes data, was blinded to group assignment. The inclusion criteria were age 18–65 years, being under MV for more than 24 h, lack of autoimmune diseases, and not using neuromuscular blocking medicines. Additionally,

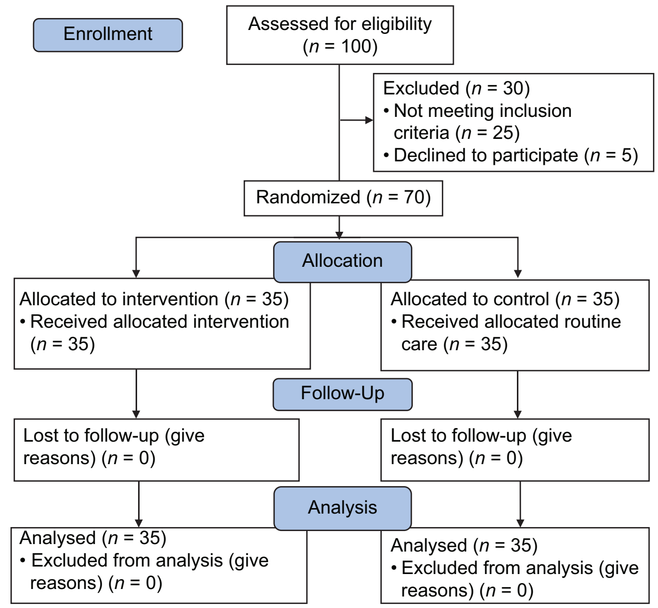

Figure 1: CONSORT Flow Diagram

the exclusion criteria were brain death, death during the study, and transference to another healthcare center.

Demographic data, vital, laboratory variables questionnaires, and the BWAP score were used for data collection. Four faculty members, two anesthesiologists, and four ICU nurses approved the face and content validity of the vital and laboratory checklists. All laboratory variables were measured in a reference laboratory affiliated with Ahvaz Jundishapur University of Medical Sciences. The BWAP score, suggested by Burns *et al*. in 2010, includes 26 items of which 12 are for general measurement and 14 for patients' respiratory function. The BWAP checklist requires an assignment of 1 of 3 responses ("yes", "no", or "not assessed") within the previous 24 hours. A yes response denotes that the factor meets the established threshold definition. A no response means that the factor does not meet the established threshold definition. Finally, the response "not assessed" is used when the available data are not enough. The effect of not assessed responses on the total score is negative as a response of not assessed accounts for a no response in the total calculation. Yes receives a score of 1, while no and not assessed receive a score of 0. The total score of the instrument is 26. When the patients are scored over 17, they are ready for weaning so that the process of weaning can be started.[13] Burns *et al*. reported the reliability of the BWAP score as 0.96, which confirms the internal consistency of the questions.[13] Jiang *et al*. reported the sensitivity and specificity of the BWAP for predicting successful extubation as 81.4% and 82.1%, respectively.[22] In a study in Iran, the reliability of the BWAP score was confirmed with a Cronbach's alpha coefficient of 0.85.[23] In the present study, the reliability of the tool was measured as 0.86 with the Cronbach's α coefficient.

In the intervention group, nurses were trained for familiarity with the BWAP checklist through the face-to-face approach by a critical care nurse and by distributing educational pamphlets. Nursing interventions based on the BWAP score were designed by three nursing faculty members and two anesthesiologists and then were provided as a protocol to the ICU nurses. The nurses performed nursing care for patients under MV according to the BWAP [Table 1].

The researcher and his assistant evaluated the patients according to the checklist every day before and after visiting a specialist physician of ICU. While completing the checklist for the intervention group, they assessed the patients' readiness for weaning. The researcher and his assistant monitored the nursing interventions of the intervention group and reported any changes in the patient's condition during the doctor's visit in the morning and afternoon shifts.

If the patient received the desired score (>17), the intensive care specialist who was resident in the unit was informed. Then, the process of weaning was started according to the written instruction. In case of not obtaining the desirable score, nursing interventions were carried out with more emphasis on the main problem identified in BWAP throughout the day [Table 1]. In the control group, the patient was weaned experimentally with the physician's opinion and using some criteria according to the ICU routine method. In the routine weaning method, the patient must have the following conditions: alert or at least as vigilant as possible to keep his airway open, good cough and swallow reflex, normal respiration without a ventilator, respiration rate not being more than 35, Spo2 above 90, and ability to lift the head from the bed and bear T-Tube. Only the checklist of vital and laboratory variables was completed for the control group. In both groups (intervention and control), during the weaning, all the patients were monitored closely. In case of any of the following conditions, which indicate the patient's intolerance, the intervention was terminated and the patient was reconnected to the MV device: O_2sat <90%; partial pressure of oxygen in the arterial blood (PaO_2) lower than 60 mmHg with FIO2 greater than 40%, and partial pressure of carbon dioxide in the arterial blood ($PaCO_2$) greater than 50 mmHg; PH of arterial blood equal to or greater than 7.32; respiration rate more than 38, or 50% increase compared to the baseline for 5 minutes or more, heart rate more than 140, or constant increase or decrease of more than 20% compared to the baseline, systolic blood pressure more than 180 mmHg or less than 90 mmHg, the existence of agitation, sweating, paradox respiration, unconsciousness, or instability of the brain.

Recording the Burns score, the consequences of weaning in the first section were successful and unsuccessful weaning. Here, unsuccessful weaning included the inability to tolerate spontaneous respiration after weaning from the MV device, re-intubation, and the need for ventilation support in the first 48 hours. On the other hand, the spontaneous respiration of the patient for 48 hours without weaning ventilation support was successful. All the patients in the intervention and control groups were separated from the MV device and eventually transferred to the general ward. In the second step, after weaning, the MV time, the number of times of reconnection to the ventilator, the number of re-intubations, RSBI rate in the days under MV and on the day of weaning, the duration of hospitalization in ICU, vital and laboratory indices before and after weaning were separately calculated in both groups.

The data were entered into the SPSS software (version 16, SPSS Inc., Chicago, IL, USA) after being collected and analyzed. The factors were examined using the Pearson correlation coefficient, Mann-Whitney U, Fisher, and Chi-square statistical tests. The level of significance was considered at $p < 0.05$.

Ethical considerations

This paper was extracted from an ICU nursing master's thesis registered at the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences with the registration code of IR.AJUMS.REC.1397.599. The patients' families completed the informed consent form and they were assured that the information of the patient would remain confidential.

Results

Table 2 presents the characteristics of the participants. As can be seen, there are no statistically significant differences between the intervention and control groups considering age, gender, and history of underlying illness according to Mann-Whitney U and Fisher's exact test. Also, there are no significant differences between the intervention and control groups regarding the mean level of GCS in patients on the day of ICU admission (p = 0.301) and at the time of weaning of MV (p = 0.231). The mean RSBI obtained using the Mann-Whitney U test on the day of ICU admission (z = -0.68, p = 0.495) and weaning day (z = -0.54, p = 0.588) did not show any significant differences between the intervention and control groups [Table 2].

Table 3 shows the mean time of attachment to the ventilator in the intervention group (11.05 days) and the control group (12.00 days), which was one day shorter in the intervention group compared to the control group. Nevertheless, there were no significant differences according to the Mann-Whitney U test (p = 0.410). The results also showed that the mean duration of hospitalization in the ICU in the intervention group was shorter than that of the control group. However, the Mann-Whitney U test showed no significant differences between the intervention and control groups (p = 0.240).

The results also indicated a significant difference between the mean of re-intubation (z = -3.27, p = 0.001) and the

Table 1: Descriptions and Definitions of General and Respiratory Factors of BWAP* and Relevant Nursing Interventions

BWAP	Eligibility criteria	Therapeutic interventions
Hemodynamic stability	Stability of heart rate and rhythm and blood pressure without the use of vasoactive drugs or administration of any oral medication, Hct ** >25% (or base)	Cardiac and CVP *** monitoring checking ventilator setting, considering side effects of drugs, skin turgor test for dehydration, and control of hemorrhage and paying attention to gastrointestinal bleeding detected through NG-Tube **** lavage and presence of melena
Metabolic stability	Absence of sepsis, active infection, thyroid disorders, and seizure	Monitoring body temperature and WBC *****, assessment of color and amount of sputum and using sterile techniques for suctioning airways, control of seizures and administration of anticonvulsant drugs
Hydration & Electrolytes	Assessment of absorption, excretion, and weight	Control of Intake and output, testing skin turgor, peripheral edema, cervical vein dilation and reporting abnormal electrolyte levels
Nutrition	Assessment of serum albumin levels	Skin turgor test, correcting low serum albumin levels, daily sodium, and potassium control, considering muscle weakness and sensitivity, the start of TPN ****** if administered, assessment of abdominal distension and bloating, slow gavage, and control of residual volume
Comfort, Adequate sleep and rest	No pain - No sleep disturbance	Assessment of pain symptoms including physiological parameters (e.g., tachycardia, tachypnea, perspiration, and intolerance of ventilator machine), opiate infusion, avoid unnecessary routine patient care, reduce alarms and ringtones, avoid talking loudly at night
Anxiety and agitation	No anxiety and agitation	Assessment of anxiety and agitation severity based on the (RASS *******), assessment and elimination of causes of anxiety and agitation including hypoxia and hypercapnia, pain and fear, assessment of oxygen uptake, the need for suctioning, checking ventilator setting, offering simple explanations on patient care, and giving the patients enough time to be alone with their families
Bowels	Normal bowel function	Assessment of ileus or abnormal bowel function, daily control of sodium/potassium level, slow gavage to avoid cramps and diarrhea; recording the amount of received food, precise control of absorption and excretion, use of infusion pump in TPN if the patient has difficulty in excreting residuals from the body, abdominal percussion to avoid abdominal distention, changing patients' position every 2 h
Overall body strength/endurance	Moving from a supine position in the bed to hanging from the bed, keeping upright at the bedside, standing up with help, walking at the bedside, etc.	Active and passive range of motions, preventing hip external rotation through proper posture, and preventing foot drop
Breathing rate and pattern, Respiratory sounds, Chest radiograph	Normal breathing rate and pattern	Assessment of patient compliance with the machine, assessment of abnormal respiratory patterns such as Cheyne-Stokes, Kussmaul and apnea, ABG ******** assessment, suctioning, changing patients' position, and respiratory physiotherapy
Sputum	Small and clear sputum	The use of bronchodilators, the use of aseptic techniques to reduce the risk of infection, ventilator tube replacement every 24 to 48 hours, discharge of the fluid accumulated in ventilator tubes, respiratory physiotherapy, humidification of respiratory gases
Abdominal distension	No abdominal distention	Paying attention to the factors causing abdominal distension and ileus, hypokalemia and high-potassium diet, slow gavage, paying attention to patient tolerance of a semi-seated position to reduce intra-abdominal pressure and increase chest wall elastance
Endotracheal and tracheostomy tube size	Endotracheal tube ≥7.5 mm Tracheostomy ≥6	Assessment of the tube size, ensuring proper placement of the tip of the tube, and informing the need for tube replacement
Ability to maintain an open airway	Ability to cough and swallow	Encouraging the patient to cough, periodic deep breathing, respiratory physiotherapy, and airway clearance, checking swallowing ability
Strength and endurance of respiratory muscles	Negative inspiratory pressure ≤20 cm H_2O Positive inspiratory pressure ≥30 cm H_2O Spontaneous tidal volume >5 ml/kg (VC *********) >10 mL/kg	ABG control and proper setting of ventilator parameters, assessment of hyperventilation causes such as sputum accumulation, hypoxia, pain, fear, and anxiety

Contd...

Table 1: Contd...

BWAP	Eligibility criteria	Therapeutic interventions
Arterial blood gases	ABG ********	Correct setting of ventilator parameters to correct acid-base variations

*Burns Wean Assessment Program, ** Hematocrit, ***Central Vein Pressure, **** Naso -Gastric Tube, ***** White Blood Cell, ******Total Parenteral Nutrition, ******* Richmond Agitation-Sedation scale ******** Atrial Blood Gas *********, Vital Capacity

Table 2: Demographic characteristics of the studied patients and Comparison of the mean level of consciousness and Rapid Shallow Breathing Index before and after weaning in both intervention and control groups (*n*=70)

	Control Mean (SD)	Intervention Mean (SD)	Mann Whitney U Test	df	*p*
Age (y)	38.82 (14.62)	38.51 (17.38)	-0.34	-	0.729
	n	***n***	**Fisher's exact test**		
Gender: M/F	26/9	29/6	0.76	1	0.561
Underlying disease	***n* (%)**	***n* (%)**	**Fisher's exact test**		
Hypertension	7 (20.0)	5 (14.30)	0.40	1	0.752
Hyperlipidemia	1 (2.90)	0 (0.0)	1.01	1	1.000
Diabetes Mellitus	6 (17.10)	4 (11.40)	0.46	1	0.734
Lung disease	1 (2.90)	1 (2.90)	0.00	1	1.000
Cardiac disease	1 (2.90)	3 (8.60)	1.06	1	0.614
Cerebrovascular Accident	2 (5.70)	1 (2.90)	0.34	1	1.000
Cause of hospitalization	***n* (%)**	***n* (%)**	**Chi-squared test**		
Head Trauma	12 (34.30)	20 (14.30)	17.21	7	0.016
Trauma to the neck, chest, and abdomen	3 (8.60)	5 (14.30)			
Trauma to the limb	6 (17.10)	0 (0.0)			
Internal diseases	4 (11.40)	5 (14.30)			
Neurologic disease	8 (22.90)	2 (5.70)			
Trauma to the head, neck, chest, and abdomen	2 (5.70)	0 (0.0)			
Trauma to the neck, chest, abdomen, and limbs	0 (0.0)	2 (5.70)			
Trauma to the head and limbs	0 (0.0)	1 (2.90)			
Glasgow Coma Scale	**Mean (SD)**	**Mean (SD)**	**Mann Whitney U Test**		
On day of ICU admission	8.48 (3.26)	8.54 (2.55)	-1.03	-	0.301
At time of weaning of Mechanical Ventilation	12.17 (2.74)	12.82 (2.56)	-1.19	-	0.231
Four Score	**Mean (SD)**	**Mean (SD)**	**Mann Whitney U Test**		
On day of ICU admission	8.57 (2.10)	9.02 (2.75)	-0.53	-	0.590
At time of weaning of Mechanical Ventilation	13.77 (2.50)	14.17 (2.34)	-0.54	-	0.588
Rapid Shallow Breathing Index (VT/RR)	**Mean (SD)**	**Mean (SD)**	**Mann Whitney U Test**		
On day of ICU admission	40.60 (15.53)	44.68 (19.64)	-0.68	-	0.495
At time of weaning of Mechanical Ventilation	49.60 (11.61)	50.85 (11.08)	-0.54	-	0.588

mean number of reconnections to the ventilator ($z = -2.83$, $p = 0.005$), which was lower in the intervention group compared to the control group [Table 3]. The results of the Pearson correlation coefficient revealed a significant and inverse relationship between the BWAP score and the duration of connection to the ventilator in the intervention group. Thus, the higher the BWAP score, the shorter the MV time ($p = 0.041$ and $r = -0.34$).

Discussion

The results of the present study indicated that the chance of weaning was higher with an increase in the BWAP score. Although the implementation of nursing care based on BWAP score and holistic assessment of patients' readiness for weaning from MV reduce the duration of attachment to the ventilator and the duration of hospitalization in the ICU, it is not statistically significant. Also, our results showed that the use of the BWAP score reduced the frequency of reconnection to the MV and the number of re-intubations, as well as improving the vital signs (reduced respiratory rate, heart rate, and systolic and diastolic blood pressure). Moreover, the results showed statistically significant improvement in respiratory indices (increased oxygen saturation and PaO2) and levels of laboratory indicators (increased albumin and modification of coagulation tests) were measured between them. Our results are consistent with some other studies. For example, Burns *et al*. (2010) showed that patients with a BWAP score greater than 50 were significantly more likely to be weaned successfully compared to those with lower scores. The results showed that the holistic assessment of the

Table 3: Comparison of the mean of vital signs and respiratory indices and laboratory indices before and after weaning in two groups of intervention and control

		Mean (SD)		Mann Whitney U Test	*p*
		Intervention	Control		
Duration of mechanical ventilation (day)		11.05 (8.76)	12.00 (7.26)	-0.82	0.410
Length of stay in the ICU (day)		15.68 (9.80)	17.94 (10.02)	-1.17	0.240
Number of re-intubation		0.17 (0.38)	0.88 (1.10)	-3.27	0.001
Ventilator frequency reconnect		0.51 (0.81)	1.42 (1.48)	-2.83	0.005
Respiration Rate (breaths/min)	before	25.62 (5.09)	25.60 (5.18)	-0.05	0.953
	after	21.51 (1.97)	23.91 (3.96)	-3.20	0.001
Heartbeat Rate (beats/min)	before	101.91 (16.02)	107.34 (16.74)	-1.21	0.226
	after	82.57 (11.98)	100.00 (12.98)	-4.83	<.001
Systolic Blood Pressure (mmHg)	before	128.11 (19.44)	123.82 (19.04)	-0.92	0.356
	after	124.40 (12.98)	131.54 (11.72)	-2.69	0.007
Diastolic Blood Pressure (mmHg)	before	78.94 (13.17)	75.48 (12.17)	-0.91	0.359
	after	77.82 (10.19)	81.14 (10.83)	-1.33	0.182
Temperature (°C)	before	37.38 (0.64)	37.38 (0.59)	-0.53	0.591
	after	36.87 (0.38)	36.92 (0.44)	-0.58	0.561
Oxygen Saturation (%)	before	95.17 (8.26)	97.34 (1.41)	-1.17	0.241
	after	98.02 (1.40)	97.14 (2.00)	-2.27	0.023
Partial Pressure of Oxygen (mmHg)	before	77.42 (36.36)	83.37 (44.17)	-0.44	0.659
	after	104.45 (40.34)	86.57 (30.91)	-1.76	0.078
Hemoglobin (g/dl)	before	10.08 (1.37)	10.51 (1.20)	-1.21	0.223
	after	11.02 (0.85)	10.96 (0.78)	-0.48	0.625
Hematocrit (%)	before	31.35 (3.53)	32.60 (3.41)	-1.05	0.290
	after	33.63 (2.50)	33.62 (2.39)	-0.10	0.920
White Blood Cell (Cells/ mm3)	before	13.60 (7.15)	13.89 (4.22)	-1.22	0.222
	after	12.69 (6.72)	13.02 (4.61)	-0.99	0.321
Blood Urea Nitrogen (mg/dl)	before	18.74 (13.25)	18.62 (9.77)	-0.31	0.750
	after	15.57 (6.95)	14.94 (6.10)	-0.20	0.841
Creatinine (mg/dl)	before	1.10 (1.38)	0.84 (0.34)	-0.93	0.351
	after	0.89 (1.00)	0.70 (0.14)	-0.38	0.701
Sodium (mEq/L)	before	138.65 (5.47)	139.34 (4.19)	-0.94	0.346
	after	138.40 (3.47)	138.51 (3.75)	0.00	1.000
Potassium (mEq/L)	before	3.74 (0.43)	3.81 (0.56)	-1.57	0.115
	after	3.93 (0.39)	3.91 (0.46)	-0.04	0.967
Calcium (mg/dL)	before	7.80 (0.89)	7.92 (0.82)	-0.18	0.851
	after	8.48 (0.65)	8.38 (0.89)	-0.79	0.427
Phosphorus (mg/dL)	before	3.91 (0.97)	3.39 (0.88)	-2.21	0.027
	after	4.08 (1.33)	3.51 (0.99)	-1.48	0.139
Prothrombin Time (Sec)	before	14.09 (1.53)	14.07 (1.66)	-0.16	0.868
	after	13.14 (1.13)	14.12 (1.62)	-2.83	0.005
Partial Thromboplastin Time (Sec)	before	39.88 (10.46)	41.11 (11.02)	-0.67	0.499
	after	36.40 (6.24)	38.62 (6.64)	-1.62	0.104
International Normalized Ratio	before	1.27 (0.24)	1.28 (0.22)	-0.31	0.757
	after	1.13 (0.13)	1.26 (0.21)	-2.90	0.004
Albumin (g/dl)	before	3.35 (0.79)	3.46 (0.45)	-0.89	0.372
	after	3.76 (0.36)	3.52 (0.42)	-0.74	0.016

patient by nurses through BWAP significantly shortened the length of MV.[13] Jeong & Lee (2018) investigated "Clinical Application of Modified BWAP (m-BWAP) Scores at First SBT in Weaning Patients from MV". They stated that m-BWAP scores were higher in patients successfully weaned and lower in unsuccessful patients. Also, they showed the good clinical utility of the m-BWAP score at the time of first SBT to predict the likelihood of liberation from MV, regardless of the duration of MV.[14]

However, our results are inconsistent with those reported by some other studies. Kirakli *et al*. (2014) showed that the duration of MV and hospitalization in ICU in COPD patients following the weaning protocol was significantly shorter.[24] Yazdannik *et al*. (2012) examined the effect of BWAP on the duration of MV and showed that the mean duration of MV was significantly shorter in the intervention group.[23] In the present study, although the duration of MV and the duration of hospitalization in ICU decreased, the difference was not statistically significant. This can be attributed to the small size of the sample, weaning protocol, general condition of the patient, history of underlying diseases, and cause of hospitalization.

Our results also showed that the use of the BWAP reduces the number of reconnection to the ventilator and the frequency of re-intubation, as well as improving the vital signs, respiratory indices, and laboratory values after weaning. These results suggest that there might be some other effective factors among the BWAP scoring checklist elements for predicting the successful weaning from MV. So, further research is needed to identify which factors are most useful in predicting liberation from MV. The results of Mahmoudi *et al*. (2014) showed that the systolic blood pressure, heart rate, and respiration rate significantly decreased after the weaning protocol. Furthermore, PaO2, O2 sat, diastolic blood pressure, and level of consciousness significantly increased, leading to the improved physiological status of patients.[25]

There is increasing evidence that the use of protocol-directed weaning can increase nursing autonomy and critical thinking. Also, the use of a nurse-led weaning protocol can reduce ventilation times and allow nurses to monitor both patient readiness for extubation and their progress through the weaning process. Therefore, optimal nursing care must be provided for patients to minimize complications.[19,20]

The small sample size in only one hospital was the limitation of this study. Therefore, it is recommended to conduct similar studies in different communities and in multiple hospitals with a larger sample size to generalize the findings to the entire population.

Conclusion

A BWAP score greater than 17 was linked to successful weaning outcomes in ICU patients. The study showed that nurses could play a crucial role in the successful weaning of patients under MV by designing nursing care based on the BWAP. The use of this tool helps nurses in weaning the patient from the ventilator in clinical decision-making. Also, the use of this tool can mitigate the level of complications and reduce patient and health system costs by reaching a specific model for weaning the patients under MV in addition to providing consistent scientific practice in ICUs.

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Conflicts of interest

Nothing to declare.

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