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Critically Ill Patients` Outcomes: Implementing Mechanical Ventilation Liberation Nursing Strategy

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Abstract:
Background: Liberation from mechanical ventilation is an essential clinical decision. Delay in identifying appropriate weaning time resulting in increased time spent on mechanical ventilation leading to more complications and increasing medical care expenses. **Purpose of the study:** to investigate the effect of implementing mechanical ventilation liberation nursing strategy on patients` outcomes. **Design:** A Quasi-experimental research design was utilized in the present study. **Setting:** The study was conducted in the respiratory and general intensive care units at Assiut university hospital**. Patients:** A purposeful sample of 70 adult male and female patients with acute exacerbation of COPD connected to mechanical ventilator for more than 48 hours were recruited. They were divided randomly into two equal groups routine care group and checklists group each 35 patients. **Instruments:** Three tools were utilized to obtain data relevant to this study; I) mechanically ventilated patients assessment sheet, II) respiratory care-unit checklist (RCC) ventilator weaning assessment III) Patients' outcomes assessment sheet**. Results:** Significant number of patients on routine care group (25.7%, P = 0.001) had prolonged mechanical ventilation (>21 day). There was a significant decrease in Sequential Organ Failure Assessment (SOFA) score in the checklists group than the routine care group (3.29±2.72) versus (5.69±4.516) respectively P=0.009. **Conclusion:** Application of nursing strategy based on RCC for ventilation weaning assessment decrease duration of mechanical ventilation and SOFA score. **Recommendations:** Applying RCC for ventilator weaning preparedness assessment on different intensive care units.

Keywords: Liberation, Mechanical ventilation, Nursing strategy & Patients` outcomes.

Introduction
Mechanical Ventilation (MV) is a necessary device for survival in the intensive care unit. Aside from its involvement in the management of respiratory failure, it reduces the effort of breathing, improves gas exchange, and provides time for additional therapies to treat the cause of respiratory failure **(Kondili et al., 2023).**

Weaning from mechanical ventilation involves liberation of the patient from mechanical assistance and endotracheal tube removal. Recognizing the patient's preparedness for weaning from MV is a valuable issue. But weaning a patient with respiratory failure from MV is not a simple process. Inappropriate and early weaning can lead to respiratory distress and re-intubation, so weaning decision remains problematic for the respiratory therapist **(Ahmed, et al, 2023)**.

Delays to estimate patients` weaning preparedness leading to increase time spent on mechanical ventilation and Prolonged Mechanical Ventilation (PMV). As a result, patients who are experiencing PMV may develop mechanical ventilated related complications and increased morbidity as airway damage, delirium, drug dependence, or ventilator associated pneumonia, and greater death rates **(Huang et al., 2022 & Trudzinski et al., 2022).** In addition, there are non-clinical impacts including raised expenses and a higher burden on healthcare resources, for example patients with PMV have been detected to consume thirty-seven percent of intensive care units` resources **(Jia, et al, 2021).**

Although several respiratory indices and predictors forecasting weaning success have been described in previous studies, there is no agreement on the most relevant predictive parameters, especially among patients with respiratory diseases **(Abdelaleem et al., 2020).**

The Respiratory Care Unit Checklist (RCC) for assessment of mechanical ventilation weaning was designed to assist in identifying weaning readiness. It is an efficient predictor checklist of successful ventilator liberation for patients with respiratory failure, consists of elements that are clinically applicable, such as arterial blood gases, Lung sounds, and serum electrolytes level **(Lee et al., 2019)**.

Nurses spend most of their time with patients in ICU and are responsible for continuous monitoring patient's condition, assessing the patient need for mechanical ventilation support, as well as providing continuous care to mechanically ventilated patients. Nurses are also contributing for determining the patient's readiness to wean and the best time for weaning from MV (**Khalafi et al., 2016 & Ghanbari et al., 2020).**

Therefore, this study was conducted to investigate the effect of implementing mechanical ventilation liberation nursing strategy on patients` outcomes.

Significance of the study

Annually, patients who require MV support for more than three weeks globally contribute to more than half of the overall ICU costs **(Sepahyar et al, 2021)**. At intensive care units of Assiut University Hospital, the medical record revealed that twenty-five percent of critically ill patients received mechanical ventilation support for more than 48 hours from September 2021 to September 2022.

Patients with respiratory failure requiring mechanical ventilation may not find a bed in the intensive care unit because other patients have been dependent on mechanical ventilation for an extended period **(Ahmed et al., 2023)**. Therefore, the study investigated effect of implementing mechanical ventilation liberation nursing strategy on patients` outcomes.

Aim of the study

The study's aim was to investigate the effect of implementing mechanical ventilation liberation nursing strategy on patients` outcomes.

Research hypotheses

1- Patients who receive the nursing strategies for mechanical ventilation liberation experience decreased duration of mechanical ventilation and rate of weaning failure.
2- Patients who receive the intervention don't require tracheostomy when compared to patients in the routine care group.
3- Patients who receive the intervention experience less organ dysfunction than other patients in the routine care group.
4- Patients who receive the intervention experience less mechanical ventilation related complications such as pressure ulcer, upper gastrointestinal bleeding, hypotension, and pulmonary embolism than other patients in the routine care group.
5- Patients who get the intervention exhibit a lower incidence of ICU acquired muscular weakness compared to other patients in the routine care group.

Conceptual Definition:

Mechanical ventilation liberation nursing strategy refers to the systematic nursing approach that applied to ensure timely and successful discontinuation from mechanical ventilation.

Operational definition:

Mechanical ventilation liberation nursing strategy can be defined operationally as the set of specific nursing actions and interventions designed to support and manage the process of weaning a patient from MV. This includes assessment of readiness, implementation of spontaneous breathing trials, and monitoring for signs of weaning intolerance or complications such as respiratory distress, fatigue, or hemodynamic instability.

Patients and Method

Design: A Quasi-experimental research design was utilized in the present study.

Variables:

- Independent variable was nursing strategies for mechanical ventilation liberation.
- Dependent variables were critically ill patients` outcomes including muscle strength**,** duration spent on mechanical ventilation, tracheostomy use, SOFA score at discharge, and occurrence of mechanical ventilation-related complications such as pressure ulcer, upper gastrointestinal bleeding, hypotension, and pulmonary embolism.

Setting:

The study was carried out in the general and respiratory Intensive care units at Assiut university hospital.

Patients:

To achieve the study's goal, a purposeful sample of seventy adult male and female, above 18 years old, with acute exacerbation of COPD connected to mechanical ventilators for more than 48 hours were recruited. The patients were randomly allocated into two groups (checklists group and routine care group) 35 patients for each group. This study excluded COPD patients who had hemodynamic instability (need respiratory support), brain stem death (brain stem is responsible for many vital functions such as breathing, blood pressure, and heart rate), neuromuscular disorders which require special management and need long time connected on mechanical ventilation as Myasthenia gravis, or lung cancer (has poor prognosis).

formula used for determining sample size:

$$n = \frac{\mathrm{Np}(1-\mathrm{p})}{(\mathrm{n}-1)(d^2 \div \mathrm{Z}^2) + \mathrm{p}(1-\mathrm{p})}$$

n = sample size

N= population size

z = level of confidence according to the standard normal distribution (for a level of confidence of 95%, z = 1.96)

p = estimated proportion of the population that presents the characteristic of the study sample (when unknown we use p = 0.5)

d = tolerated margin of error (for example we want to know the real proportion within 5%) =0, 05

$$n = \frac{85 \times 0.5(1-0.5)}{(85-1)(0.05^2 \div 1.96^2) + 0.5(1-0.5)}$$

$$=69.75 \approx 70$$

The randomization technique: encompassed assembling 70 paper slip blocks, 35 for the checklists group and 35 for routine care group. A number (between 1 and 35) was written on each slip of paper. These slips were folded and then put into an opaque envelope. The patient's allocated group was determined by drawing one of the folded slips from the opaque packet, after which the researchers completed the remaining protocol stages.

Tools

Three tools were utilized to gather data.

Tool 1: - mechanically ventilated patient's assessment tool: The researcher developed this tool after studying the literature **(Mirzaali et al., 2020& Ahmed et al, 2023)** to establish baseline data for the patients. This tool consisted of two parts.

Part one: Patient demographic and clinical data assessment: It covers demographic data (age, gender) and clinical data includes (chest radiological findings as pneumonia, hyperinflation, pleural effusion, pulmonary embolism, and pneumothorax upon ICU admission, and vital signs assessment).

Part two: Respiratory parameters: Include arterial blood gases as PH, partial pressure of oxygen (pao2) and carbon dioxide (paco2), serum bicarbonate (HCO3), and mechanical ventilation modes and settings which involves mechanical ventilation respiratory rate, Tidal volume, Pressure support, peak pressure, fraction of inspired oxygen, and Positive End Expiratory Pressure.

Tool 2: Respiratory care unit (RCC) ventilator weaning assessment.

this tool adopted from **(Lee, et al,2019)** to assess readiness for MV liberation and composed of 3 elements, the first is physiological function assessment, including (7 items) and the second is electrolyte balance assessment which contains (7 items), and the third is respiratory function assessment contains (12 items).

Tool 3: Patient outcomes assessment tool

This tool was developed by the researcher after reviewing literature **(Mohamed et al., 2019, Sepahyar, et al., 2021, Ling et al., 2023 &El-Soussi et al., 2023)** to assess patient outcomes. This tool consisted of five parts.

Part1: Muscle strength: It was initially described by The MRC total score 1943, also utilized by **Mohamed et al., 2019,** it rated on a six-point Medical Research Council (MRC) scale. Six pairs of muscles were assessed bilaterally (shoulder abduction, flexion of the elbow, wrist extension, flexion of the hips, extension of the knee, and ankle dorsiflexion).

Scoring system: The standard six-point grading method uses a scale of 0 (no muscular contraction) to 5 (full power against maximum resistance). A score less than 48 indicates ICU acquired muscle weakness.

Part 2: Weaning outcomes: weaning success or failure rate (failing to breath spontaneously and reconnection to MV due to early weaning), and duration spent on mechanical ventilation.

Part 3: Tracheostomy need.

Part 4: Mechanical ventilation-related complications such as pressure ulcer, upper gastrointestinal bleeding, hypotension, pulmonary embolism, and ICU acquired weakness.

Part 5: SOFA score (Sequential Organ Failure Assessment)

This tool adopted from **(Vincent et al., 1996)** and applied by **(Ling et al., 2023) to** assess the degree of failure in 6 various organ systems (the respiratory, cardiovascular, hepatic, coagulation, renal, and nervous systems). It was evaluated upon discharge.

Scoring system: Each organ system is scored from 1 to 4, total scores ranging from 0 to 24.

- **Content validity:** The tool's content validity was determined by a panel of 5 experts (two professors of anesthesia and critical care medicine and one professor of Chest Diseases and Tuberculosis medicine and two critical care nursing staff) who evaluated the tools for clarity, relevance, comprehensiveness, understanding, and applicability and all necessary modifications were done.
- **The reliability of the study's tools**: Cronbach's alpha was used to assess the reliability, and the results were 0.827 (tool I) and 0.932 (tool III), which were acceptable.
- **A pilot study** was conducted with seven patients (10% of the patients and excluded from the study sample) to assess the tools' clarity, validity, and applicability.

Method

The study was conducted throughout three main steps:

Preparation:

The phase involved:

- Official permission to conduct the study was obtained from the responsible authorities of intensive care units at Assiut University following clarifying the study's purpose.
- The researcher constructed the study tools after reviewing the national and international literature.

Ethical consideration:

1. Written approval was taken from the Ethics Research Committee, Faculty of Nursing, Assiut University, with the IRB local approval number 1120240500.
2. There was not any danger to patients during the research implementation.
3. The study adhered to common ethical guidelines in clinical research as
- Voluntary participation and the right to withdraw from the study at any time without penalty.
- Beneficence and non-maleficence.
- Respect for privacy and confidentiality.
- Justice (fair participant selection).
4. Patient family provided informed written consent after clarifying the nature and goal of the study.
5. Confidentiality was guaranteed (adherence to the Helsinki Declaration).

2) Implementation:

The researcher checked patients on both groups to assess demographic data, radiological finding and clinical data when patient being admitted to ICU, as well as vital signs, and arterial blood gases (PH, Pao2 and Paco2, HCO3) assessed daily.

The routine care group:

The routine care group was weaned based on the physician's judgment using some criteria according to the routine ICU method such as sputum amount, respiratory rate, rapid shallow breathing index, level of consciousness, and radiological finding and arterial blood gases.

The checklists group:

The checklists group received nursing strategies for mechanical ventilation liberation.

Patients were screened for eligibility for MV weaning daily and scored using respiratory care unit checklist (RCC) for ventilation weaning assessment by the researcher. The score involved physiological function assessment, electrolyte balance assessment, and respiratory function assessment. The physiological functions (7 items) included heart rate, blood pressure, temperature, fluid balance, bowel movement, chest X-ray, and pain).

The electrolyte balance assessment of (7 items) Na, K, Ca, Mg, phosphorous levels, hematocrit > 25%, and albumin > 2.5 g/dl. The respiratory function (12 items) involved Maximal inspiratory pressure ≤ -20 to -25 cmh2o, tidal volume > 5 ml/kg, rapid shallow breathing index < 105 min/L, minute ventilation < 10 L/min; Ph., paco2, pao2, respiratory rate, lung sounds, sputum character, coughing ability; and presence of tracheostomy. Every item was graded on a two-point scale (1 = yes that means normal and 0 = No that means abnormal). The score is determined by dividing the total number of yes answers by 26 and multiplying by 100. If the score exceeded or equaled 67%, the patients had a greater possibility for successful liberation. Patients with a score below 67% had a higher possibility for failed weaning **(Lee, et al, 2019)**.

When the score was less than 67%, nursing strategies and care implemented concentrating more on the noted element that decreases the RCC score.

Nursing strategies used to improve RCC score:

Respiratory function: Respiratory rate, ABGS, lung sounds, sputum (amount, colour, character), and coughing ability were assessed. Postural drainage position was maintained for 5 minutes; percussion and vibration were applied followed by suction. The patient was pre-oxygenated with 100% before suction; oral care was done every 6 hrs. Respiratory circuit was humidified using humidifier which replaced every 5 days. Elevating the head of the bed between 30-45 %, and early mobilization within 24-48 hours of ICU admission included turning patient every two hours, active/passive range of motion every 2 hrs, and sitting up in a chair while awake **(Eweas , et al., 2020 &Hassan , et al., 2022)**.

Sedation: daily sedation interruption. Sedation score was assessed using Richmond agitation-sedation scale (RASS*)* evaluation and adjusted the sedative drug injection dose with physician to achieve ideal RASS score (-1 to 1) to prevent respiratory muscle weakness due high sedation dose **(Taran, et al., 2019).**

Hemodynamic status: Heart rate, blood pressure, intake and output, and skin turgor assessed daily. ensure good hydration: intake/output should be more than 1500 ml for the past 3 days before weaning , fluids were given for hypotensive patient guided by central venous pressure measurement. Gastrointestinal bleeding was detected through ng-tube lavage and presence of melena and controlled by infusion of antacid, giving fluid, and decreasing peep and inspiratory pressure according to oxygenation improvement **(Lee, et al., 2019, Abdelaziz, et al., 2020& Sepahyar, et al., 2021).**

Pain: Pain was assessed by using behavioral pain scale. Nonpharmacological pain-relieving measures such as imaging, deep breathing and coughing exercise. Lidocaine inhalation before suctioning, sedation, and analgesia was received as prescribed by the physician **(Taran, et al., 2019& Sepahyar, et al., 2021).**

Temperature: Monitoring body temperature hourly WBC count, in case of fever cold application, and antipyretics was given. Strict aseptic technique during invasive procedures to reduce the risk of infection. Hand hygiene before and after dealing with patients. Intravenous catheters, urinary catheters, nasogastric tube changed regularly **(Abdelaziz, et al., 2020).**

Nutrition and bowel problems: Enteral nutrition within 24 hours of ICU admission. Patient's requirement: 25-35 kcal/kg/day, prepared formula (30–35% of total calories lipid, carbohydrates 45–50, and a protein of 1.2 – 1.5 g/kg/body weight) was given. Patients were monitored for signs of feeding intolerance, vomiting and abdominal distention. In patients with gastric feeding intolerance IV metoclopramide was used as a prokinetic therapy. Feeding was given slowly, and patients placed on a semi-fowlers position during feeding **(Rondanelli, et al., 2020 &Singer, et al., 2023).**

When patients obtained scores of 67%, the physician was informed, and patients were weaned gradually and endotracheal tube removed if the patients were stable and hadn`t any signs and symptoms of respiratory distress as respiration rate > 35, shortness of breathing, systolic blood pressure more than 180 mmHg or less than 90 mmHg, rapid pulse > 140 b/min, agitation, decreased conscious level, and increased sweat.

Evaluation:

*ICU outcomes of both groups evaluated utilizing tool III.

- The researcher assessed muscle strength to the patients in both groups after weaning utilizing MRC to evaluate for the presence of intensive care unit acquired weakness (ICU-AW).
- Both groups were evaluated from beginning of MV connection to weaning or death for complications related to mechanical ventilation as pressure ulcer, upper gastrointestinal bleeding, hypotension, and pulmonary embolism.
- Patients in both groups were evaluated for duration of mechanical ventilation, weaning failure, tracheostomy use, and SOFA score at discharge.

Statistical analysis:

The data was captured electronically and analyzed using SPSS (version 22). The independent samples t-test was performed to compare quantitative data among two groups. The Chi-square test was performed to compare qualitative variables and establish their significance. The threshold of the test's "P" was considered to be statistically significant when the p-value was less than 0.05.

Results:

Table (1): Distribution of patients regarding demographic characteristics and clinical data

Demographic characteristics and clinical data		Checklists group (n=35)	Routine care group (n=35)	P-value
Sex	**Male**	25 (71.4%)	22(62.9%)	.445
	Female	10 (28.6%)	13(37.1%)	
Age	18- <36	3(8.6%)	3(8.6%)	.587
	36-<51	3(8.6%)	1(2.9%)	
	51-65	29(82.9%)	31(88.6%)	
Chest x-ray findings	Pneumonia	19 (54.3%)	21(60.0%)	0.629
	Hyperinflation	10 (28.6%)	11(31.4%)	.794
	Pleural effusion	6 (17.1%)	4(11.4%)	.495
	Pulmonary embolism	1(2.9%)	1(2.9%)	1.00
	Pneumothorax	0(0%)	1(2.9%)	.314
	Free	5 (14.3%)	2(5.7%)	.232

NS there is no significant difference p .value > 0.05.
-Independent samples t-test for comparing two groups
-Chi-square test for qualitative variables.

Table (2): Comparison between the checklists and routine care groups in relation to mechanical ventilator sitting

MV sitting	Checklists group (n=35)		Routine care (n=35)	P- value
Respiratory rate	12.34±1.52		12.27 ± 2.07	.875
Tidal volume	467.20± 29.23		455.00 ± 34.01	.188
Fio2	43.41± 9.34		41. 30± 12.18	.434
Pressure support	11.79 ± 3.28		12.30± 5.14	.654
PEEP	6.15±1.54		5.91 ± 1.70	.547
Ppeak	22.77± 7.30		24.60 ± 6.66	.355

NS there is no significant difference p .value > 0.05.
-independent samples t-test for comparing two groups
Fio2: fraction of inspired oxygen, PEEP : positive end expiratory pressure, Ppeak: Peak pressure

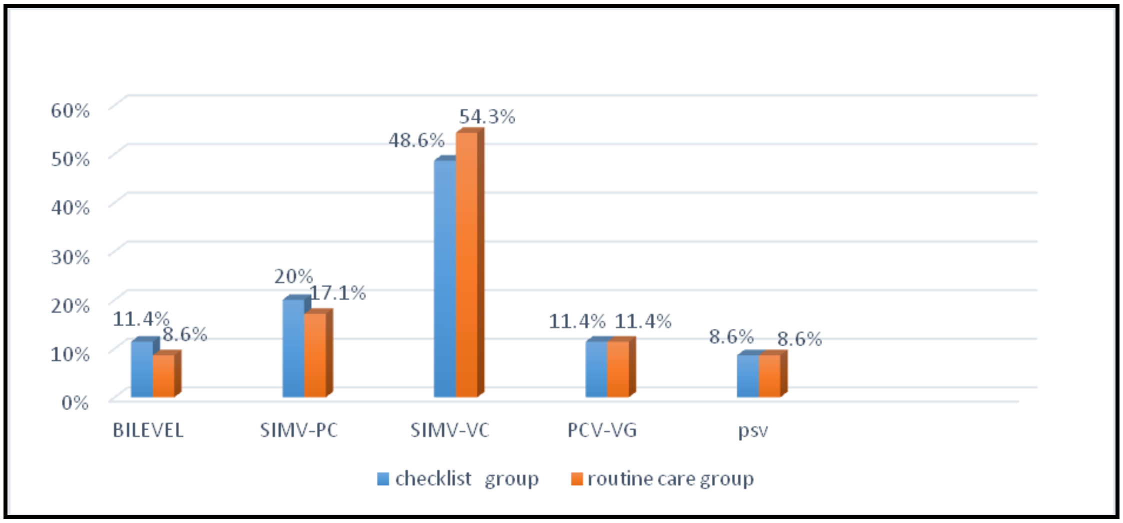

Figure (1): Comparison between the checklists and routine care groups in relation to mechanical ventilator modes

Table (3): Comparison between the checklists and routine care groups in relation to patients' outcomes

Patients' outcomes	Checklists group (n=35)	Routine care group (n=35)	P-value
Weaning failure	4(11.4%)	17(48.6%)	0.008*
Prolonged mechanical ventilation (> 21 day)	0(0%)	9(25.7%)	.001*
Muscle strength	50.93±9.73	46.64±12.98	.167
Tracheostomy	1(2.9%)	9(25.7%)	.006*
SOFA score	3.29±2.72	5.69±4.516	.009*

NS there is no significant difference p .value > 0.05.
** Significant difference p .value < 0.05.*
-Independent samples t-test for comparing two groups.
-Chi-square test for qualitative variables.

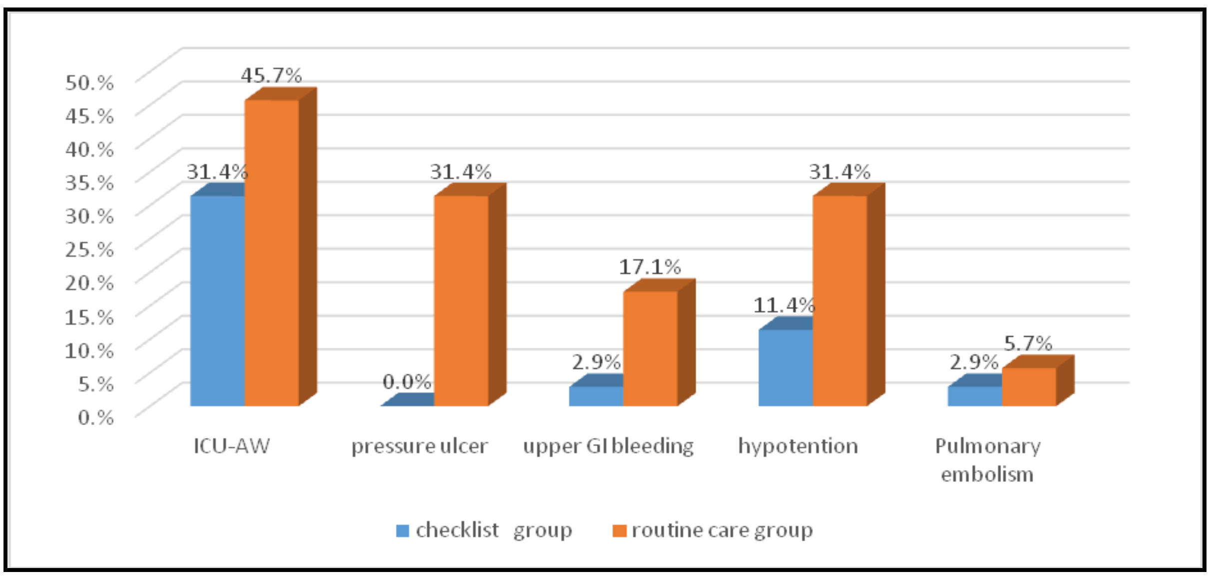

Figure (2): Comparison between the checklists and routine care groups in relation to mechanical related complications.

Table (1): Show distribution of patients regarding demographic characteristics and clinical data. Regarding the patients' demographic characteristics, there was no statistically significant difference between the two groups (p. Value >0.05). It was observed that most of the studied patients in both groups were between 51 and 65 years old (checklists, 82.9 & routine care group, 88.6%). The study sample was predominantly males, which constituted 71.4% of the checklists group and 62.9% of the routine care group.

The finding revealed that pneumonia is the most common cause of COPD exacerbation and ICU admission 19 (54.3%) patient on checklists versus 21(60.0%) on routine care group and there was no statistically significant difference between the two groups (p. Value >0.05). There is no significant difference between the two groups in relation to radiological findings.

Figure (1): Shows comparison between the checklists and routine care groups in relation to mechanical ventilator modes: the findings revealed that a great percentage of the checklists and routine care groups (48.6%, vs 54.3%, respectively) utilized synchronized intermittent mandatory ventilation-volume control mode.

Table (2): Provides comparison among the studied groups in terms of MV sitting. There was no statistically Significant difference between the two groups (p. Value >0.05) regarding RR, Tidal volume, Pressure support, PEEP, and Peak.

Table (3): provides comparisons among the studied groups in the context of patient outcomes:

- There was no significant difference (p .value > 0.05) among the studied groups in relation to muscle strength,
- Regarding the SOFA score at discharge there was a significant decrease in SOFA score at discharge in the checklists group compared to the routine care group (3.29±2.72) versus (5.69±4.516) respectively. In terms of weaning outcomes, the weaning failure rate was significantly higher in the routine care than that of the checklists group (48.6%, versus11.4%) respectively. A significant number of patients on routine care group have prolonged mechanical ventilation.
- The number of patients who had a tracheotomy was lower in the checklists group than in the routine care Group 1(2.9%) versus 9(25.7%) respectively.

Figure (2): Shows comparison between the checklists and routine care groups in relation to mechanical related complications. The checklists group had significantly lower rates of pressure ulcers, upper gastrointestinal bleeding, and hypotension than the routine care group 0(0.0%) versus11 (31.4%), 1(2.9%) versus 6(17.1%), 4(11.4%) versus11 (31.4%) respectively. However, there was no significant difference in the occurrence of pulmonary embolism among the studied groups 1(2.9%) versus 2(5.7%), both the checklists and routine care group had ICU acquired weakness 11 (31.4%) versus 16 (45.7%) respectively.

Discussion

The current study revealed that the implementing of mechanical ventilation weaning nursing strategy based on respiratory care unit checklist for ventilator weaning assessment was associated with better patient`s outcomes due to decrease the occurrence of prolonged mechanical ventilation.

Regarding the patients' demographic and clinical data, there was no significant statistical difference between the two groups (p. Value >0.05), this indicates that the two groups are matched. This result finding matched with **Belenguer et al., 2023** who reported that no significant difference on demographic data of enrolled patients on their study of protocolized weaning versus conventional weaning. In contrast this findings didn`t match with **Oliveira et al., 2019** study which found that there was statically significant increase in age of patients on experimental group than the control and female patients predominated within the two groups.

No significant difference between the two groups in relation to radiological findings, this indicate that the two group has the same disease severity, **Hasenstab et al., 2021** reported that classifying of patients with chronic obstructive lung disease according to computed tomography severity can predict the development of disease and possibility of death. Pneumonia was the most common cause of respiratory failure on COPD and ICU admission as radiological studies proved that more than half of patients on the studied suffering from pneumonia, this result correlate with the findings of **(Niu et al., 2021**) study which found that approximately one-third of patients with COPD diagnosed with pneumonia based on an appearance of consolidation on chest X-ray.

__No significant difference between the two groups regarding mechanical ventilation modes, and sittings. This finding matched with the finding of **Hammouda et al.,2022** study conveyed that no statistically significant differences were observed between both groups `ABGS, and ventilator parameters. SIMV-VC was used by most of the studied group. **Salem et al., 2023** found that the SIMV VC group exhibited a statistically significant improvement in lung mechanics, ventilator indices, oxygenation, and hemodynamic state compared to the BIPAP group. However, the current study's findings contrasted with those of **Al-Banna et al., 2016,** who reported that more than two thirds of the study group received continuous mandatory ventilation (CMV) mode.

In terms of weaning outcomes, the weaning failure rate was significantly higher in the routine care than that of the checklists group. This is due to the application of an RCC ventilator weaning assessment in the checklists group as a weaning strategy, which was effective in predicting suitable time for weaning. This finding matched with **(Yekefallahet al., 2019)** who studied the impact of the Persian weaning tool (PWT) on outcomes of patients connected to mechanical ventilation and stated that the PWT increases rates of weaning success. In contrast **Oliveira et al., 2019** who studied the Impact of a ventilatory weaning protocol in an intensive care unit for adults found that there wasn't statistically significant difference observed between the studied groups regarding number of weaning attempts and success rate**.**

A significant number of patients on routine care group experience prolonged mechanical ventilation, this due to delay on weaning decision, this result is consistent with the result of **Ahmed et al., 2023** study which found that nearly fifty percent of the routine care group spent more than 20 days attached to the ventilator. On the other hand, this findings **Yekefallah et al., 2019** found that the implementing of the Persian Weaning tool hadn`t significant effects on duration of mechanical ventilation**.**

There was no significant difference between the two groups in relation to muscle strength, thirty percent of the patients in the checklists group experienced ICU-acquired weakness, compared to around forty-five percent of the routine care group, this result matching with study results **Wang et al., 2021,** which highlighted that Skeletal muscle dysfunction is one of the significant systemic manifestations of COPD. This was attributed to COPD characterized by the loss of muscle mass, and muscle strength that aggravated by decreases physical activity due to dyspnea and exercise restriction.

The number of patients who had a tracheotomy was lower in the checklists group than in the routine care group, this difference related to an increase in time spent on mechanical ventilation on the routine care group, this finding matching with **(Belenguer et al., 2023)** who found that the number of patients who required a tracheotomy in the conventional weaning group was higher than in the protocol-directed weaning group. In contrast, this finding contrasted with the study of **Oliveira et al., 2019** Who studied the effect of a mechanical in an adult's ICU found that ventilator weaning protocol group hadn`t any significant difference concerning with tracheostomy.

Regarding to SOFA score at discharge, there was significant decrease in SOFA score at discharge in the checklists group than the routine care group, **Damanik et al., 2019** stated there was a positive correlation between SOFA score and duration of time spent on ventilator. This attributed to prolonged mechanical ventilation increase morbidity rate as positive pressure ventilation causing elevating intrathoracic pressure, and intraabdominal pressure causing decreased cardiac output, GIT injury, renal impairment and associated with increased SOFA score , patients in checklists group received nursing intervention including hemodynamic , respiratory , and nutritional management lead to improving RCC score and weaned earlier leading to decrease duration of mechanical ventilation and it`s related complications leading to decrease SOFA score .

In terms of complications, the checklists group had significantly lower rates of pressure ulcers, because patient on routine care group suffering from prolonged mechanical ventilation increasing the risk of developing pressure ulcer, checklists group had decreased mechanical ventilation duration due to application of nursing strategies and early ambulation that led to decrease rate of developing pressure ulcer. This matched with the result of **Herer, 2020** which found that higher incidences of pressure ulcers were seen in the respiratory intensive care unit combined with prolonged MV. There was no significant difference in the incidence of pulmonary embolism comparing both groups, and there was a decrease in incidence of pulmonary embolism within the two groups this due to patients on both groups received anticoagulant therapy. This result supported by the result of **El-Soussi et al., 2023** study which found that there was no significant variation in the rates of pulmonary embolism within both study groups. The checklists group had significantly lower rates of hypotension, this finding supported **Thomas et al., 2021** study results which highlighted that positive pressure Ventilation causing decreased venous return due to elevated intrathoracic pressure, resulting in a drop in cardiac output.

The checklists group had significantly lower rates of upper gastrointestinal bleeding, **El Nagar et al., 2022** found that a high percentage of upper gastrointestinal haemorrhage in critically ill patients receiving artificial ventilation. Upper gastrointestinal haemorrhage was most likely because of MV that led to lower cardiac output and diminished tissue perfusion, resulting in stomach mucosal ischemia.

Limitations of the Study:

The major limitation of this study was the small sample size, this is due to most patients with COPD treated by high flow nasal cannula and oxygen therapy.

Conclusion:

Application of nursing strategy based on respiratory care unit checklist for weaning assessment increase weaning success probability, decrease duration of mechanical ventilation and minimizing MV related complications.

Recommendations:

Given the present study's results, certain recommendations were proposed:

- Providing a workshop for nurses on how to apply the respiratory care-unit checklist (RCC) for ventilator weaning assessment.
- Employing RCC to assess weaning readiness as a regular clinical assessment tool.
- Future research: To generalize the study results, it should be replicated with a larger probability sample in a multicenter. In addition, future research should include patients with respiratory failure due to different causes, such as neurological disorders.

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