Effect of Multimodality Chest Physiotherapy on Extubation and Critically Ill Mechanically Ventilated Patients Outcomes

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Abstract

Background: In the intensive care units' ICUs, both physiotherapy and extubation are two important and closely related interventions that may enhance the patient's recovery. **study** aimed to investigate the effect of multimodality chest physiotherapy on extubation and critically ill mechanically ventilated patients' outcomes. **Subjects and Methods:** Quasi-experimental research design was used. **Sampling** A purposive sample included 100 mechanically ventilated patients taken from respiratory ICU in Aswan University Hospital. **Data collection tools:** Tool 1, critically ill patient clinical profile was used for collecting data, it included three parts: bio-demographic and clinical data, hemodynamic and respiratory parameters, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scale. Tool2, Chest physiotherapy modalities including its include, inspiratory muscle training (IMT) device, passive, and positive range of motion, and early mobilization in addition to conventional chest physiotherapy**. Results:** the outcome data among both groups, there were considerable variance regarding the duration of mechanical ventilation (MV), length of ICU stays, negative inspiratory force (NIF), extubation outcome, reintubation, noninvasive ventilation NIV, and mortality rate (P = 0.023, 0.012, 0.045, 0.047, 0.012, 0.021, 0.017 respectively). Moreover, where there was considerable variance between the extubation subcategories among the study group regarding serum potassium, APATCHE II scale, duration of MV, length of ICU stays, and the need for NIV (P= 0.031, 0.002, 0.003, 0.001, 0.000 respectively). **Conclusion:** The application of Multimodality chest physiotherapy can improve Extubation and patient outcome compared to traditional chest physiotherapy. **Recommendation:** Nurses and physicians in all ICU could be advised to apply the Multimodality chest physiotherapy in their sitting.

Keywords: Extubation, mechanical ventilation, critical ill, chest physiotherapy, Multimodality, patient outcome, and ICU.

Introduction:

Critical disease is a serious public health concern around the world due to high death rates and expensive healthcare expenses. As a result of recent developments in medical care technology, patients on ventilator support have had a better prognosis and survival rate of severe illness **(Rose et al. (2016).**

Extubation, has become a time-sensitive procedure. Reintubated patients had a poor prognosis, increased mortality, longer ICU stays, more need for patient tracheotomies, and a worse functional outcome after recovery. As a result, preventing extubation failure in critical care setting is a major public health problem **(Rishi et al. (2015).**

Mechanical ventilation (MV) is one of the most widely used methods of treatment for critically ill patients. Up to 90% of patients worldwide need mechanical ventilation (MV) causes respiratory muscle weakness which is associated with prolonged duration of mechanical ventilation and may be even noticed several days after successful weaning for some or most of their stay at the ICU , As a result, successful extubation is a major challenge for intensive care staff (**Coyer et al.(2017).**

An extubation failure is characterized as the need for reintubation within 48 hr. of tube remova l and the new agreement on weaning has been ide ntified as a lack of mechanical assistance for 48 h after extubation **(Dres et al. ,20**17).

Chest physiotherapy is one such common preventive strategy where critical care nurses routinely introduce care to most of the ICU patients with various chest physiotherapy techniques such as Manual hyperinflation,

suctioning, patient positioning, chest vibrations, chest percussions, various coughing techniques in combination or individually to prevent pulmonary complications in the ICUs **(Meawad et al.,2018).**

Percussion and vibration and shaking methods are based on the assumption that applying an external force to the chest wall to loosen the mucus facilitates airway mobilization and clearance, it involves rhythmical beating with properly shaped hands on the chest wall over specific regions of the lungs and removing the mucus **(Arumugam et al.,2019)**

The role of pathologies such as swelling and laryngeal edema in increasing risk must be understood in order to reduce the incidence of failure to extubate. Screening for risk factors that may predispose to extubation failure can improve the chances of success. We have used new ICU intubation and extubation data from the last decade to update existing guidelines **(Thille et al. (2019).**

Delivering high-quality care to successfully extubate the critically ill patient is essential to critical care nurses. Extubation of ventilated patient is a method of constant contact between nurses and doctors, which is an innovative system in which acts are not always accompanied by stated objectives. In the intensive care setting, this is often one of the biggest challenges facing nurses. For this purpose, intensive care nurses need to apply the specific approaches that will have a positive impact on the mechanically ventilated patient's extubation and help the patient move towards desired outcomes **(Jerpseth et al. (2017).**

Significance of the study

Reintubation of mechanical ventilated patient is associated with a poor prognosis and prolonged duration of ICU stay. Patients who require reintubation have a 50% higher mortality rate than those who have failed Extubation **Perren et al. (2018),**

According to several research, secretion volume plays a significant effect in extubation failure. Increased secretion volume was linked to a 7.4 times higher chance of extubation failure in individuals with a good cough reflex (relative risk (RR) = 7.4, CI = 0.95-57.1). Extubation failure was 31.9 times more likely in patients with a weak cough reflex (RR = 31.9, CI = 4.5-225.3), the importance of airway secretion clearance. **Khamiees et al. (2017).**

However, there is no existing studies that has examined the correlation between chest physiotherapy modalities and extubation patient outcome.

Aims of the study:

The present study aimed to investigate the effect of multimodality chest physiotherapy on extubation and critically ill mechanically ventilated patients' outcomes.

Research hypothesis:

Physiotherapy multimodality has positive effect on extubation predictors & the patient outcome, in terms of length of stay and mortality rate among mechanically ventilated respiratory intensive care patients.

Subject and Method

Operational definition:

Extubation failure: recognized as the need to be reintubated within 72 hours after extubation.

Patient outcome: The change in the patient or system that results from implementation of the multimodality chest physiotherapy.

Research design:

Quasi-experimental research design was used to conduct this study.

Sample:

A convenient sample of 100 intubated mechanically ventilated critically ill patients who were admitted to respiratory ICU. The total sample was divided into 2 groups (each group containing 50 patients) Patients were selected by means of a simple random sample using a raffle by a coin (king and writing) for each intubated critical ill adult patient entered the respiratory ICU, the study group was considered the king (received multimodality chest physiotherapy additional to traditional chest physiotherapy as a routine care of respiratory ICU) and the control group was considered the writing which taken only the routine traditional chest physiotherapy.

(1) Control group:

Fifty patients were subjected to conventional or traditional chest physiotherapy (percussion, vibration and endotracheal suction).

(2) Study Group:

Fifty patients were subjected to application of multimodality physiotherapy chest in form of inspiratory muscle training (IMT) via threshold IMT device passive and positive range of motion and early mobilization in addition to conventional patient's protocol.

Setting of the study:

The study was conducted in respiratory intensive care unit at Aswan university hospital, Egypt, the study was carried on 100 intubated, mechanical ventilated patients over a period of six months from the beginning of February 2019 until the end of July 2019.

Inclusion criteria:

1) Patient's age is more than 18 years old.
2) Patients on invasive mechanical ventilation for more than24 hours.
3) Hemodynamic parameters are stable: mean arterial blood pressure 65-110 mmHg, heart rate 40-150 beat/min, respiratory rate 5-35 breaths/min and SaO2 ≥88%.

Exclusion criteria:

1) Progressive neuromuscular disease that may restrict with chest physiotherapy application.
2) Increased intracranial tension.

Study tools:

Two tools were utilized to collect data in this study. They are developed by the researchers after passing through an extensive and relevant review of literature. The validity & reliability of these tools were revised by a panel of critical care nursing staff, and medical respiratory disease staff experts, and then pilot study was done.

First Tool: Critically ill patient clinical profile:

This tool was developed by the researcher based on reviewing of the relevant literature and used to assess the studied patients regard the socio-demographic data and medical related data as base line data, it includes 2 main parts as flowing.

Part I-Socio- demographic and clinical data of the patient

Which include: - Patient data as (age& sex). History of current disease, past medical diseases, cause of admission, medical diagnosis and body mass index, comorbid disease Laboratory investigation are taken according to hospital protocol, and APACHE II scale, **Adopted** by **Akavipat„et al.,(2019).** The underlying assumption guiding the development of this instrument was that the severity of illness of acute disease is measured by quantifying the degree of abnormality of multiple physiologic variables.

Part II Assessment of hemodynamic and Respiratory parameters:

Which includes (Temperature, pulse, blood pressure, respiration, pulse oximetry, secretions characters, arterial blood gases ABGS,) developed by the researchers.

Second Tool: Multimodality chest physiotherapy This tool was developed and modified by the researchers after reviewing the relevant literature **(Bissett, et al, 2016), (Nafae et al, 2018), (Hanekom et al in 2013)and (Zhu,etal ,2018)**. Chest physiotherapy modalities Performed by researchers. it includes the following main parts:

- **Multimodality chest physiotherapy procedure including the following modalities:**

Criteria before application Multimodality chest physiotherapy procedure

- The study group received their first chest physiotherapy after the connection with mechanical ventilation.
- Before and during application of the chest physiotherapy techniques, oxygen saturation, heart rate, respiratory rate, and mean arterial pressure were closely monitored.
- Each modality of the chest physiotherapy was performed for 30-40 minutes, and chest physiotherapy were given until the patient was discharged from the ICU.

Discontinuation of PT sessions: The session was discontinued if;

- Mean arterial blood pressure <65mmHg or>110mmHg, systolic blood pressure >200 mmHg.
- Heart rate (HR) <40 beats /min or >130 beat/min.
- Respiratory rate (RR) <5 breath /min or > 35 breath /min.
- SaO2 <88% (pulse oximetry).

First multimodality chest physiotherapy:

✓ **Manual hyperinflation**, **expiratory rib cage compression, vibrations, cough function training and endotracheal suction** are performed in session lasted in 30 minutes:

- All study subjects were placed in dorsal decubitus position to complete the chest maneuvers session.
- The manual hyperinflation technique performed by disconnected the patient from the mechanical ventilator and inflating the lungs with larger volumes than ventilator breaths.
- Using the manual hyperinflation device (ambu bag) with inspiratory pressure ≤ 40 cm H2O and FIO2 at 0.6, inducing a tidal volume increase and generating.
- Breathing session consists of a slower, deeper inspiration, an inspiratory hold and a quick release of the reservoir bag to increase the expiratory flow rate. In order to improve oxygenation, prevent collapsed alveoli and improve lung compliance.
- Manual hyperinflation was performed at the same time as the tracheal suction, with 5–6 ventilatory cycles during each tracheal secretion suctioning.
- Expiratory rib cage compression consists of creating mechanical strength is transmitted through the chest wall into the airways during the exhale's stage to redirecting and increasing airflow for improve patent air way clearance and secretion removal.
- The vibrations were accomplished by isometric contraction of the forearm muscles, working in synergy with the palms of the hands perpendicular to the chest, to improve mucociliary depuration.
- Tracheal aspiration was implemented by using aspiration cannula size 10 or 12 and normal saline solution at 0.9% using at most10 mL throughout the aspiration process which was introduced gently and slowly to remove secretions.
- The number of aspirations performed depended on the amount of secretions the vacuum level was standardized at 30 cm Hg.

Second multimodality chest physiotherapy:

✓ **Inspiratory muscle training using threshold inspiratory device: (Bissett et al, 2019)**

- Pressure threshold setting obtain by adjustable, spring loaded, threshold poppet valve device.
- Wide range of training intensities between 9-41 cm H2O are provided by the device.
- Patient must generate an inspiratory negative pressure higher than the indicated threshold pressure setting to compress the spring and open the poppet valve.
- The inspiratory negative pressure must be sustained above the threshold pressure to maintain the poppet valve open.
- The device releases an auditory feedback once a successful breath is completed due to oscillatory motion of spring.
- Connected to endotracheal tube or mouse piece with the patient in bed 45 head-up tilt. It was applied twice daily till extubation at 9 am, 6 pm.
- Starting with 9 cm H2O and each session was consisted of 4 sets of 6-8 breaths and each session was increased by 4 cm H2O and 5 min in duration maximum 30 min.
- A period of 1-2 minutes rest between sets was done, during which the patients was placed on the ventilator.

Third multimodality chest physiotherapy:

✓ **Limb exercises, positioning and early mobilization:**

- In the procedure of passive or active assisted movement for the 4 limbs (2 sets for each limb and each set 10 repetitions).
- Upper limbs exercises for the wrist; elbow and shoulder, shoulder abduction, adduction,

and flexion and extension; and internal and external rotation.

- Primarily performed these exercises against gravity in a supine position and progressed to a sitting position as tolerated.
- Lower extremity exercises included ROM exercises for ankle dorsiflexion and plantar flexion, hip and knee flexion and extension, and straight leg raising,
- 10 repetitions of each motion per set for 2 sets in the supine position.
- Contained within turning from side to side on the bed; transfers to and from the bed, chair, and; and coming to a standing position.
- Ambulation was instituted as early as subjects could tolerate it.
- semi-Fowler (sitting at a 45° angle), and sitting positions.

Fourth multimodality chest physiotherapy:

✓ **Chest wall mobilization:**

- The researcher placed one hand over the subjects' abdomen and the other on the upper chest.
- Subjects then were instructed to observe the increased hand motion over the abdominal area during inspiration while keeping the movement of the upper chest as small as possible.
- The researcher then performed a quick stretch inward and upward in the abdomen area at the end of expiration.

All of the exercises were performed according to procedures reported.

Outcome measure

- Duration of ICU length stay.
- Extubation outcome (Extubation success, or Extubation failure).
- Need patients to reintubation.
- ICU mortality.

Methods for data collection:

Ethical considerations

- Administrative approval was obtained from the responsible persons (directors of Aswan University Hospital and head of respiratory intensive care unit).
- Written approvals were taken from the patients and patient relative after presenting ourselves to them and explaining the purpose of the study.
- There is no hazard for study subject during application of research.
- Confidentiality and anonymity were assured.
- Study subject have the right to refuse to participate and or withdraw from the study at any time.

This study was carried out through three consecutive phases:

(Preparatory phase, implementation phase and evaluation phase).

Preparatory phase:

This phase started by local, international, current and past related literature in various aspects of the extubation problem among mechanically ventilated critically ill patients.

Validity and Reliability: The tools were tested for content validity by 5 experts of academic nursing and medical staff from Aswan University. Modifications were done accordingly, and then the tools were designed in its final format and tested for reliability by using internal consistency for the tools measured using Cronbach test, the tools proved to be reliable (0.87).

Pilot study

A pilot study was carried out on (10%) of the sample (100 patients), critically ill mechanical ventilated patient to assess the applicability of the tools, the feasibility of the study and to estimate the time needed for data collection. Analyses of the pilot study revealed that minimal modifications are required. These modifications were done and the subjects were excluded from the actual study. Based on the results of the pilot study and expert's opinion, modifications and omissions of some details were done and then set the final fieldwork schedule.

Field working phase:

- The researchers collected the data during a period of six months from the beginning of February 2019 until the end of July 2019. This was done during the routine work of the ICU at every shift. The assessment sheet requires about 10-30 minutes filling; about 3-4 critically ill mechanical ventilation patients were collected per week.
- At the respiratory intensive care unit, the researchers introduced themselves and

informed the nurses about the nature of the study.

- In six months, duration we enrolled 100 patients, divided into 50 patients (control group) for usual care (suction, vibration, percussion and positioning) and 50 patients (study group) for chest physiotherapy modalities.
- During this phase, the researchers explained the aim of the study, components, technique and the importance of implementing chest physiotherapy modalities concisely to mechanical ventilated patients in ICU and the informal.
- After obtain the patients consent for voluntary participation in the study.
- If the patients were unable to give consent, their relative would sign the consents instead. For the demographic information, it consisted of baseline data, it included age, Gender, Marital status, educational level, duration of stay in ICU.
- The patient bio-demographic data were collected from the patient record.
- Assessment was done for all patient at admission for detect and motoring by using tool one.
- Chest physiotherapy modalities intervention was applied for all subject grouped enrolled in the study.
- The researchers explain and implement chest physiotherapy modalities intervention in three or more session according patient condition.
- Each session takes from 30 to 40 minutes and monitoring patient condition criteria for readiness to apply chest physiotherapy close monitoring during implementation and observed patient tolerance if any signs of discontinuation criteria was appeared immediately stopped the chest physiotherapy modalities session. each session content were as follow:

First session: this session implemented daily during morning shift it initiated by the researchers introduced themselves to the patients telling them; purpose of the meeting, orient patients regarding chest physiotherapy modalities Contents of this session included; brief introduction about chest physiotherapy and methods to improve cooperation of patient (Manual hyperinflation**,** expiratory rib cage compression, vibrations, cough function training and endotracheal suction). This session finished by a summary of its content and motoring the patient.

Second session: This session was implemented during afternoon shift three items from chest physiotherapy modalities was applied by researchers it includes (**Inspiratory muscle training using threshold inspiratory device**, chest wall mobilization and posture drainage), Most patients were cooperative and interested in a given topic and asked to continue the nursing management.

Third session**:** This session was implemented at begging night shift the remain two mediates from chest physiotherapy was applied by researchers it includes **(**extremity range of motion and early mobilization) researchers was implementing physiothotherapy, and early mobilization according patient condition.

Evaluation phase:

This phase was emphasized on estimating the effect of the multimodality chest physiotherapy intervention by monitoring extubation predictors, patient outcome evaluation through a comparison between both study and control group the rate of ICU stays, duration of mechanical ventilators days, mortality rate, rate of extubation successful or failure for all studied patients through tool I.

Statistical analysis:

Statistical analysis was done by SPSS, version 21 (IBM Inc., Armonk, New York, USA). Nonparametric tests were utilized in the current study. $P \leq 0.05$ deliberated statistically important.

Results:

Table (1): Current study involved 100 subjects (study group 50 subjects & control group 50 Subjects), The medical diagnosis 70% of the study were have COPD in while 82% of control group were have 82% COPD, no considerable variance between both groups regarding the demographic data, and the presence of co-morbidities ($P > 0.05$ respectively)

Table (2), (3): Regarding the vital data at the first day of ICU, APACHE score, arterial blood gases (ABG), and laboratory data, Moreover, ABG and Negative Inspiratory Force (NIF) readings before weaning from mechanical ventilation ($P > 0.05$) no substantial variance between both groups as shown in Tables (2), (3).

Table 4: As regard the patients outcome data among both groups, there were considerable

variance between both groups regarding the duration of mechanical ventilation, length of ICU stays, Negative Inspiratory Force (NIF), extubation outcome, need for reintubation, need for noninvasive ventilation (NIV), and mortality rate (P = 0.023, 0.012, 0.045, 0.047, 0.012, 0.021, 0.017 respectively), however, no significant variance regarding RSBI was noticed (P= 0.62) as shown in (Table 4).

Table 5: illustrated that the comparison between both extubation outcome subcategories among the study group, where there was considerable variance between them regarding serum potassium (K), APATCHE II scale, duration of mechanical ventilation, length of ICU stays and the need for NIV (P= 0.031, 0.002, 0.003, 0.001, 0.000 respectively). However, no considerable variance was detected regarding age, sex, diagnosis, RSBI, NIF results) as shown in table (5).

Table (1): Frequency distribution of Socidemographic data for critically ill mechanically ventilated paints both group n = 100 (n= 100)

Personal data	Study (n= 50)		Control (n= 50)		P-value
	No.	%	No.	%	
Sex:					
Male	32	64.0%	30	60.0%	0.680
Female	18	36.0%	20	40.0%	
Age: (years)					
Mean ± SD	57.88 ± 12.62		58.00 ± 15.61		0.966
Smoking status:					
Smoker	27	54.0%	23	46.0%	0.424
Non-smoker	23	46.0%	27	54.0%	
Smoking index:					
Median (Range)	20.0 (0.0-60.0)		0.0 (0.0-50.0)		0.212
Body mass index (BMI):					
Mean ± SD	28.52 ± 6.98		28.33 ± 6.22		0.866
Previous MV	13	26.0%	9	18.0%	0.334
Hospitalization last year:					
Once	26	52.0%	33	66.0%	0.353
Twice	15	30.0%	10	20.0%	
Three or more	9	18.0%	7	14.0%	
Diagnosis:					
COPD	35	70.0%	41	82.0%	0.160
Overlap syndrome	10	20.0%	6	12.0%	0.275
Bronchial asthma	2	4.0%	1	2.0%	1.000
Interstitial lung disease	2	4.0%	0	0.0%	0.495
Acute severe asthma	1	2.0%	1	2.0%	1.000
OHS	0	0.0%	1	2.0%	1.000
Comorbid diseases:					
Diabetes mellitus	13	26.0%	16	32.0%	0.509
hypertension	19	38.0%	21	42.0%	0.683
Renal diseases	5	10.0%	9	18.0%	0.249
Hepatic diseases	9	18.0%	4	8.0%	0.137
Obesity diseases	9	18.0%	11	22.0%	0.617
Ischemic heart disease	3	6.0%	5	10.0%	0.715
Arrhythmia	1	2.0%	1	2.0%	1.000

Data are presented as mean ± SD, or number and percentage (%).P-value<0.05 is considered statistically significant COPD: Chronic obstructive airway disease. OHS*:* Obesity hypoventilation syndrome (OHS)

Table (2): Frequency distribution of Clinical data at the first day of ICU admission of all the study population (n=100)

	Study (n= 50) Mean ± SD	Control (n= 50) Mean ± SD	P-value
Vital signs:			
Mean blood pressure	81.92 ± 21.66	88.34 ± 21.99	0.145
Heart rate	117.06 ± 16.79	116.00 ± 19.25	0.770
Temperature	38.02 ± 0.51	37.90 ± 0.54	0.262
Fluid balance	806.58 ± 553.99	883.48 ± 695.09	0.869
APATCHE score	21.22 ± 3.59	20.30 ± 3.57	0.202
Lab investigations:			
S. albumin	25.74 ± 5.95	26.38 ± 6.25	0.606
Na	133.42 ± 8.40	134.52 ± 8.75	0.523
K	2.90 ± 1.19	3.18 ± 1.21	0.252
Mg	1.92 ± 0.46	2.01 ± 0.44	0.296
Ca	8.82 ± 0.79	8.89 ± 0.60	0.660
Hemoglobin (HB)	12.20 ± 2.09	12.47 ± 2.23	0.540
ABG at admission:			
PH	7.25 ± 0.07	7.26 ± 0.09	0.288
$PaCO_2$	75.82 ± 19.79	68.92 ± 23.64	0.117
PaO_2	42.82 ± 4.67	41.92 ± 4.92	0.351
PaO_2/ Fio_2	146.66 ± 42.23	136.98 ± 34.97	0.215
HCO_3	33.36 ± 9.46	31.68 ± 9.72	0.383
SO_2	71.04 ± 7.19	71.78 ± 8.16	0.632

*Data are presented as mean ± SD, or number and percentage (%).*P-value<0.05 is considered statistically *significant. Na=sodium. K=potassium. Ca= calcium. Mg= magnesium. ABG: Arterial Blood Gases. APACHE: acute physiology and chronic health evaluation*.

Table (3):): Frequency distribution of Clinical data before weaning(n=100)

	Study (n= 50) Mean ± SD	Control (n= 50) Mean ± SD	P-value
ABG before weaning:			
PH	7.40 ± 0.04	7.39 ± 0.05	0.070
$PaCO_2$	54.94 ± 10.73	55.18 ± 10.31	0.909
PaO_2	80.66 ± 11.03	78.60 ± 14.07	0.257
HCO_3	42.36 ± 10.21	40.10 ± 12.73	0.330
SO_2	96.26 ± 5.29	94.14 ± 6.50	0.077
NIF	-21.76 ± 4.96	-21.06 ± 5.13	0.490

*Data are presented as mean ± SD, or number and percentage (%).*P-value<0.05 is considered statistically significant. *NIF***:** *negative inspiratory force*

Table (4): Comparison between study and control group as regard of Outcome, extubation outcome data(n=100).

	Study (n= 50)		Control (n= 50)		P-value
Duration of M.V: Mean ± SD	5.80 ± 2.07		6.14 ± 2.03		0.023*
Length of ICU stay: (days) Mean ± SD	7.74 ± 3.46		9.74 ± 4.07		0.023**
RSBI: Mean ± SD	102.74 ± 50.90		107.98 ± 55.91		0.627
NIF: Mean ± SD	-21.76 ± 4.96		-18.41 ± 5.13		0.045*
Extubation outcome:					
Success	40	80.0%	31	62.0%	0.047*
Failure	10	20.0%	19	38.0%	
Need for reintubation	3	6.0%	12	24.0%	0.012*
Tracheostomy	2	4.0%	5	10.0%	0.436
Need for NIV	12	24.0%	23	46.0%	0.021*
Mortality	4	8.0%	13	26.0%	0.017*

*Data are presented as mean ± SD, or number and percentage (%).*P-value<0.05 is considered statistically significant. *MV = mechanical ventilation. ICU =* intensive care unit *RSBI: respiratory shallow breathing index NIF***:** *negative inspiratory force. NIV:* noninvasive ventilation

Table (5): Comparison into Subgroup category according to the extubation outcome in the study group(n=50)

	Success (n= 40)		Failure (n= 10)		P-value
	No.	%	No.	%	
Sex:					
Male	26	65.0%	6	60.0%	1.000
Female	14	35.0%	4	40.0%	
Age (years) Mean ± SD	58.20 ± 12.60		56.60 ± 13.28		0.724
Diagnosis:					
COPD	29	72.5%	6	60.0%	0.462
Overlap syndrome	9	22.5%	1	10.0%	0.663
Interstitial lung disease	1	2.5%	1	10.0%	0.363
Acute severe asthma	0	0.0%	1	10.0%	0.200
Bronchial asthma	1	2.5%	1	10.0%	0.363
S. albumin: Mean ± SD	25.60 ± 5.57		26.30 ± 7.62		0.743
K Mean ± SD	3.64 ± 1.22		2.72 ± 1.12		0.031*
APATCHE: Mean ± SD	19.45 ± 3.49		22.30 ± 2.11		0.002*
Duration of M.V: Mean ± SD	5.80 ± 3.20		12.80 ± 5.55		0.003*
Length of ICU stay: (days) Mean ± SD	7.92 ± 3.85		14.00 ± 7.60		0.001*
RSBI: Mean ± SD	98.83 ± 50.36		118.40 ± 52.66		0.163
NIF Mean ± SD	-21.33 ± 5.14		-23.50 ± 3.95		0.224
Need for NIV:					
Yes	4	10.0%	8	80.0%	0.000*
No	36	90.0%	2	10.0%	

*Data are presented as mean ± SD, or number and percentage (%).*P-value<0.05 is considered statistically significant. *MV = mechanical ventilation. ICU =* intensive care unit *RSBI: respiratory shallow breathing index NIF***:** *negative inspiratory force. NIV:* noninvasive ventilation

Discussion

In the critical ICUs, the application of physiotherapy is to provide advanced nursing intervention techniques to decrease ventilator dependency, prevent risk of the reintubation and to make a better patient's outcome. Early physiotherapy may avoid extubation failure, limitation of mobility and complete ventilator dependency. So, both physiotherapy and period of extubation are two important and closely related interventions that enhance the patient's recovery **(Ambrosino et al., 2017).**

The current study aimed to investigate the effect of the application of the multiple chest physiotherapy modalities on outcome data of critically ill mechanically ventilated patients in respiratory ICU. This study concluded that the use of multiple chest physiotherapy modalities nursing intervention among the critical ill adult mechanically ventilated patients in the respiratory ICU, can reduce of the incidence of extubation failure, mortality rate, ICU length of stay, duration of mechanical ventilation and the reintubation rate.

This study demonstrated that the combination of the conventional chest physiotherapy with early mobilization (EM), and IMT (as achieved by using a threshold pressure device) can be allied with an increase in the incidence of extubation success in the study group. In accordance with our results, **Cader et al. (2010), Condessa et al. (2013), Dixit and Prakash (2014), a**pplied a training load using a threshold pressure device to achieve adequate IMT and their results are summarized that IMT combined with chest physiotherapy is more effective in improving extubation outcome from mechanical ventilation.

Other studies, such as **Bisset et al., (2012) and Pascotini et al., (2014),** found that the implementation of an IMT method protocol employing a threshold device on a study group was safe for use in selected ventilated patients with no notable detrimental effects during Extubation from mechanical ventilation.

Furthermore, IMT can improve inspiratory muscle strength of the inspiratory muscles, endurance of the inspiratory muscle endurance **(Özyürek et al, 2014),** expiratory muscle strength **(Ibrahiem et al, 2014)** and decreases the duration of weaning duration in critically ill patients with a prolonged MV duration **(Cader et al,2010) and (Shimizu et al, 2014).**

Recently, **Worraphan et al, (2020)** recommended that IMT or EM should be indorsed for ameliorating the weaning results in mechanically ventilated cases. However, an interpretation with caution is required due to the heterogeneity. Nevertheless, some studies have showed no substantial variation in the duration of weaning, weaning accomplishment, or re-intubation after IMT **(Martin et al, 2011) (Elbouhy et al, 2014)].** Also, **Moreno et al, (2019)** found that respiratory muscle training did not demonstrate efficacy in the reduction of the weaning period of mechanical ventilation nor in the increase of respiratory muscle strength in the study population.

This study demonstrated that, with the use of multiple chest physiotherapy modalities in the study group, the length of stay in the ICU was dramatically shortened, the reduced length stay of ICU was decreased e due to the implementation of the chest physiotherapy modalities by researchers that playing a vital role in the lessening of airways secretions agglomeration, improve lung compliance, and prevent lung complications, avoid respiratory and peripheral muscle wasting. In harmony with our results**, Mohamed et al. (2014)** illustrated that the ICU length of stay was considerably lower in their intervention group compared with the other group.

Furthermore, Calvo et al, (2015), Perme et al, (2017) and Mendez et al, (2018) summarized that the reduction in the time of hospitalization as consequences of the early mobilization with traditional chest physiotherapy can be effective to ameliorate the skeletal muscular system issues, strengthen the diaphragm, and boost the cough function. However, previous studies by **Kayambu et al., (2015) and Hodgson et al., (2016)** have presented conflicting results outcome in response to chest physiotherapy modalities intervention.

From the researchers' point of view, mechanical ventilation ICU Patients are required of multiple chest physiotherapy methods the improving recovery responses of patients that lead to reduce rate of the ICU length of stay. Although successful extubation rate was also found to be significantly higher in intervention group in the current study which highlighted the

important role of chest physiotherapy modalities for patients requiring mechanical ventilation.

The findings of the current study also show that early mobilization interventions such as sitting, standing, and walking can be advantageous for patients recovering from an ICU stay who are on a ventilator. This study's CPT includes not only airway clearing, but also procedures to help with lung volume expansion, such as chest wall mobilization and expiratory rib-cage compression. Early mobilization and lung volume expansion exercises, in addition to typical airway clearance procedures, may have contributed to the lower rate of Extubation failure in this study.

In the present, the reintubation rate of the study group was noticeably lower than the control group (38% versus 20%- p = 0.047). **Thille et al. (2013)** found that their reintubation rate was between 10 and 20%. Furthermore, **Wang et al, (2018)** illustrated that the reintubation rate of the study group was substantially lower than the control group (8% versus 16%- P = .01).

In the current study, the interventions were reduced death rates. However, little study has been done on the link between CPT and mortality. Patients with acquired muscle weakness had a greater mortality rate, according to **Ali et al (2015).** Patients receiving full-time (24-hour/day) physiotherapy care have a reduced death rate (OR = 1.3; p = 0.04) than those receiving part-time (6-hour/day) physiotherapy care, according to **Castro et al. (2013).** However, **Wang et al, (2018)** found that there is no substantial variation in the decease rates between both the study and control groups (1% and 3%, correspondingly).

This study show, the reintubation rate and death rate was decreased may be due to the implementation of the chest physiotherapy multimodality by researchers is vital role in reduction of air ways secretion accumulation, improve lung compliance, and prevent lung complications. Furthermore, prevent respiratory and peripheral muscle atrophy that consequence from using mechanical ventilators.

We found that there was considerable variance between both extubation subcategories among the intervention group regarding serum K, APATCHE II scale. In accordance with this result, **Yu et al, (2020)** summarized that the variables that might be allied with extubation failure in severe pneumonia cases comprised APACHE II score above 17. Furthermore, we found that the duration of MV, and the need for noninvasive ventilation NIV is substantially higher in the extubation failure subcategory (P= respectively). Similarly, extubation failure triggered a longer duration of mechanical ventilation (P < 0.001) and a longer ICU length of stay (P < 0.001) **(Wang et al, 2018).**

This study's results are anticipated to be the foundation of the applying the chest physiotherapy multimodality as a part of nursing intervention in intensive care units and provide high-quality nursing services that can increase level of successful extubation among mechanically ventilated patient and improve the patients outcome.

Limitations:

It is a single center study with a small sample size. This study is subject to selection bias that might not fully reflect all intensive care cases, our outcomes assessments did not include functional measures which is also an important outcome for ventilated cases. So future studies with randomized controlled designs are needed to confirm our findings.

Conclusion

Extubation success is one of major challenges facing nurses in a critical care setting. The application of multi chest physiotherapy modalities can be associated with reduction of extubation failure, mortality frequency, and length of ICU stay.

Recommendations

1. In most ICUs, chest physiotherapy is considered an integral part of the interdisciplinary team, but its cost effectiveness needs to be examined carefully via further research trials.
2. Future study is needed to discover the best timing to begin IMT, as well as the best load to apply and how to increase it, in order to obtain the intended training effect.
3. The effects of IMT on long-term ventilator-dependent patients must be studied in randomized controlled studies.

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