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To Compare the Effect of Anterior Basal Lift Versus Abdominal Co-Contraction Technique on Ventilatory Parameters in Mechanically Ventilated Patients - A Randomized Control Trial

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ABSTRACT

BACKGROUND: Patients who are unable to maintain the level of ventilation necessary for maintaining gas exchange functions can benefit from mechanical ventilation for that Physiotherapy is key. Anterior Basal Lift (ABL) & Abdominal Co-Contraction (AC) are techniques of proprioceptive neuromuscular facilitation (PNF) that produce reflex-respiratory movement response & improve ventilatory parameters in mechanically ventilated patients.
NEED OF STUDY: There is dearth of literature on respiratory PNF technique in mechanically ventilated patients, so this study is aimed to determine effect of AC and ABL technique in mechanically ventilated patient.
OBJECTIVE: To compare effect of Abdominal Co-Contraction and Anterior Basal Lift technique on ventilatory parameters [Saturation of Peripheral Oxygen (SPO_2), Respiratory Rate (RR), Lung compliance, Heart Rate (HR), Tidal Volume] in mechanically ventilated patients.
METHODOLOGY: 30 participants were included in study and divided into 2 groups: A (ABL) & B (AC). Patients were given intervention for 3 days and pre and post outcomes were observed. Data were taken at baseline & after 3 days of intervention.
RESULTS: Data were analyzed by SPSS21 & t-test was applied. Statistically significant improvements were observed in both groups but more pronounced in group A ($P<0.05$) [Tidal Volume ($t= 3.24$), RR ($t=2.16$), HR ($t=2.06$), Lung Compliance ($t=7.38$), SPO_2 ($t=2.50$)].
CONCLUSION: Anterior Basal Lift is more effective in reduction of RR & HR and improving Tidal Volume, Lung Compliance & SPO_2 over Abdominal Co-Contraction in mechanically ventilated patients.
CLINICAL IMPLICATIONS: Respiratory PNF is feasible, safe & effective. This can be used as early intervention in mechanically ventilated patients.

Keywords: Anterior basal lift, Abdominal Co-Contraction, Mechanical Ventilator, Respiratory PNF

INTRODUCTION

An intensive care unit, or ICU, is a type of hospital allocated specifically for treating patients who have serious illnesses, injuries, or problems that could endanger their lives.[1] Mechanical breathing was necessary for between thirty and sixty percent of patients who were admitted to the intensive care unit (ICU). Out of 1590 patients, the overall death rate in the ICU was 30.7%.[2,3] Mechanical ventilation is a useful treatment for patients who are unable to sustain the volume of ventilation necessary to maintain gas exchange functions. Mechanical

ventilation may be required when a patient experiences a variety of factors, such as head trauma, drug overdose, etc., that lead to ventilatory failure or oxygenation failure. These factors include physiologic changes, such as lung parenchymal deterioration, disease states, such as respiratory distress syndrome or atelectasis, an excessive ventilatory workload, such as airflow obstruction, medical or surgical procedures, and post-anesthesia recovery.[4]

Pressure support ventilation (PSV), synchronized intermittent mandatory ventilation (SIMS), continuous positive airway pressure (CPAP), and bilevel positive airway pressure (BiPAP) are examples of mechanical ventilation systems that are commonly used.[4]

People who use mechanical ventilation are more likely to suffer from possibly devastating consequences.[5] Complications associated with mechanical ventilation include barotraumas, hypotension, arrhythmia, oxygen toxicity, multiple organ failure, atelectasis, ventilator-associated pneumonia, ARDS (acute respiratory distress syndrome), pneumonia, airway injury, laryngeal injury, alveolar damage, and diaphragm disuse atrophy.[6,1]

Critical area physical therapy goals include maintaining bronchial hygiene, improving bed mobility, reducing the need for a ventilator, lowering the risk of pulmonary complications, and assisting the patient in weaning off of one.[7] Therefore, in order to improve ventilatory parameters, it is essential to promote routine chest physical therapy.[8]

When there is not enough ventilation, secretions are held in. Deranged mechanical respiratory function is another frequent result. A "stiff chest exhibiting little respiratory movement" is an additional option. This could be due to increased intercostal muscle tone or a disease related reduction of costal mobility.[9]

The term "Neurophysiological Facilitation Of Respiration" refers to the application of proprioceptive and tactile stimuli externally that appear to change the depth and rate of breathing while eliciting reflex respiratory movement responses. Proprioceptive neuromuscular facilitation (PNF), which incorporates the methods of anterior basal lift and abdominal co-contraction, is one of the physiotherapy modalities.[9]

When respiratory proprioceptive neuromuscular facilitation techniques are used, the body changes its breathing rhythm, returns mechanical stability quickly, and exhibits evident deeper inspiration, wider expansion of the ribs, increased tone in the abdominal muscles, and so on.9 It will enable a higher tidal volume and enhance hemodynamic and compliance characteristics.[10]

Maintaining pressure and stretch anteriorly and posteriorly is made possible by the anterior basal lift. It promotes increased epigastric movement and rib excursion from the bucket and pump handle. Spindle muscle activation this method has the potential to occur and trigger reflexive inspiratory action. Proprioceptors found in the spinal and lower intercostal muscles may be stimulated to control phrenic motor neurons reflexively.[11,9]

Margaret Rood (1973) taught a technique called co-contraction of the abdomen to aid with respiration. The tone of the abdominal muscles rose as a result. Rood believed that the diaphragm was also stimulated by the co-contraction of the abdomen. This would activate the muscle spindles and they in turn would cause their homonymous extrafusal muscles to contract The contraction of these muscles would in turn stretch the abdominal muscles on the other side (the side nearest the therapist's hands). The stretch would activate the spindles in these muscles which in turn would activate their own extra fusal muscle. A contraction would result and muscles on the other side would again be stretched.[12]

Physiotherapy in the intensive care unit involves combining many modalities. There is little data on individuals who use chest physical therapy in addition to respiratory PNF while patient is on ventilatory support.

Therefore, the present study has been undertaken to compare the effect of abdominal co-contraction and anterior basal lift technique on ventilatory parameters in mechanically ventilated patients.

There is a dearth of literature on respiratory proprioceptive neuromuscular facilitation technique in mechanically ventilated patients, so this study is aimed to determine the effect of abdominal co-contraction and anterior basal lift technique in mechanically ventilated patient.

AIM & OBJECTIVES

AIM–

To compares the effect of abdominal co-contraction versus anterior basal lift technique on ventilatory parameters in mechanically ventilated patients.

OBJECTIVES –

1. To determine the effect of abdominal co-contraction technique on ventilatory [Heart Rate, Tidal Volume, Lung Compliance, Respiratory Rate & saturation of peripheral oxygen (SPO2)] parameters in mechanically ventilated patients.
2. To determine the effect of Anterior basal lift technique on ventilatory [Heart Rate, Tidal Volume, Lung Compliance, Respiratory Rate, and Saturation of peripheral oxygen (SPO2)] parameters in mechanically ventilated patients.
3. To compare the effect of abdominal co-contraction versus anterior basal lift technique on ventilatory [Heart Rate, Tidal Volume, Lung Compliance, Respiratory Rate & Saturation of peripheral oxygen (SPO2)] parameters in mechanically ventilated patients.

HYPOTHESIS

NULL HYPOTHESIS

There is no significant difference between abdominal co-contraction versus anterior basal lift technique on ventilatory parameters in mechanically ventilated patients.

ALTERNATE HYPOTHESIS

There is significant difference between abdominal co-contraction versus anterior basal lift technique on ventilatory parameters in mechanically ventilated patients.

MATERIALS & METHODS

MATERIALS

SOURCE OF DATA:

1. Pranayam Lung and Heart Institute, Vadodara
2. GMERS hospital, Vadodara

STUDY DESIGN: Randomized controlled trial

STUDY DURATION: 10-12 months

STUDY POPULATION: Mechanically ventilated patients

PROPOSED SAMPLE SIZE: 33

SAMPLING METHOD: Simple random sampling method

INCLUSION CRITERIA[1]

1. Mechanically ventilated patients with endotracheal intubation or tracheostomy or Non-invasive face mask.
2. Age between 18-45 years

EXCLUSION CRITERIA [1]

1. Patients with Rib fracture, chest trauma and thoracic vertebra fracture.
2. Patient underwent thoracic or abdominal surgery past 3 months.
3. Patients with uncontrolled fever and infection
4. Malignancy

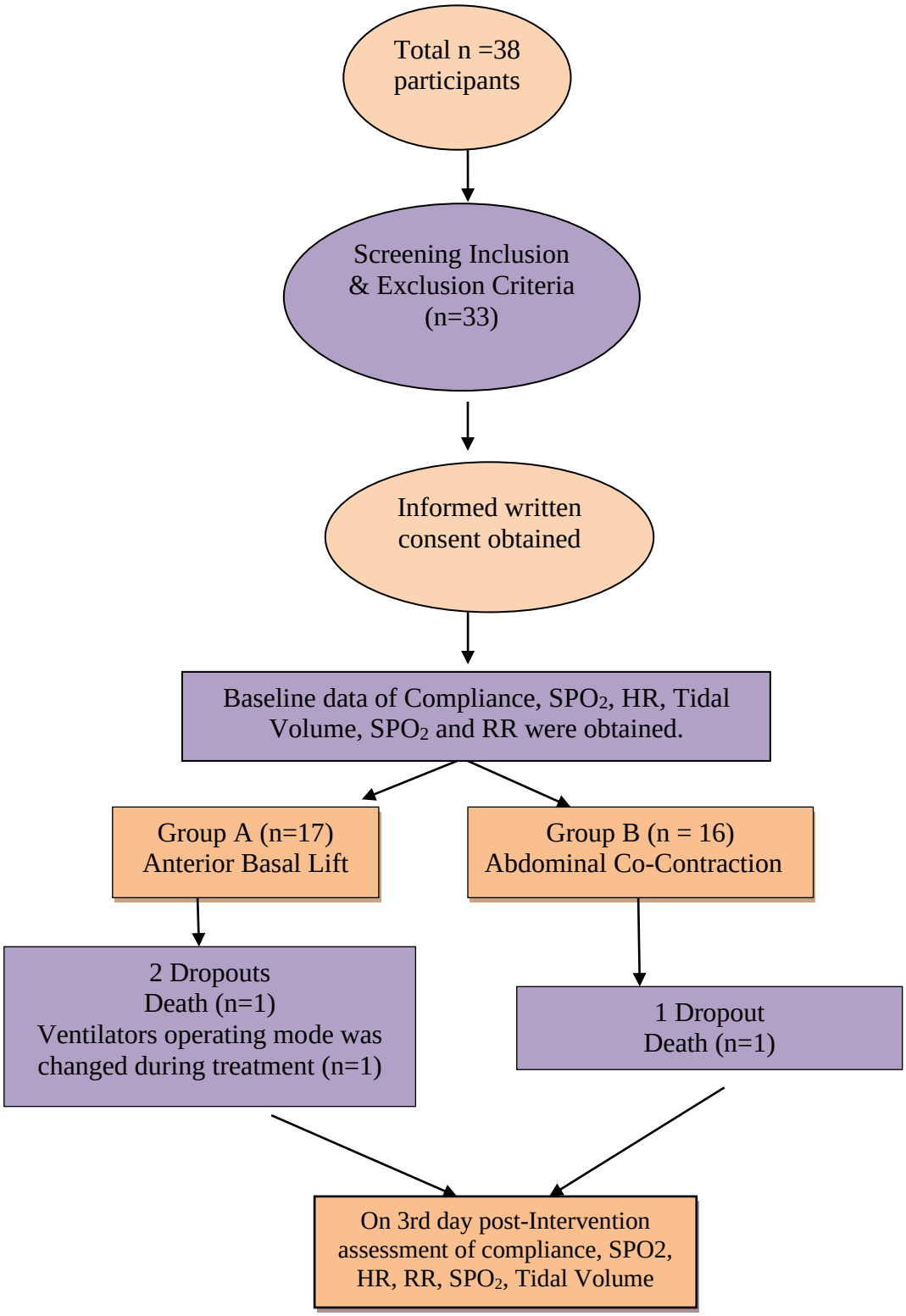


Fig 1: Flow Chart representing the procedure of selection of participants

METHODOLOGY

PROCEDURE

33, mechanically ventilated Patients were included in the study based on inclusion criteria. Written informed consent was taken from all the patients or relative who agreed to participate. Patients were allocated randomly in 1:1 ratio to either Group A n = 15 (Anterior Basal lift technique) or Group B n = 15 (Abdominal Co-Contraction). Participants in each group received training two times per day for 3 days. Conventional

tailored made physiotherapy treatment were given in the form of positioning, mobilization, manual hyperinflation (MH), percussion, chest vibrations, suction, cough techniques, and breathing exercise to both the groups.[13,14] Data were taken at the baseline and after 3 days of intervention. The patients were continuously monitored throughout the treatment.

INTERVENTION

A group of 33 participants were divided in to two groups

Group A – Anterior Basal Lift Technique [n=17]

Group B – Abdominal Co-Contraction [n=16]

Group A:

Group A received Anterior Basal Lift technique

PT assessment was taken before and after the treatment. Ventilatory parameters also monitored throughout the treatment. The patient is in the relaxed supine lying position (same for group B). Anterior Basal Lift procedure is performed by placing the hands under the posterior ribs of the supine patient and lifting gently upward. The lift is then maintained while the patient continues to breath in his/her usual manner.[9] As the lift is sustained and stretch is maintained there will be increase in epigastric movement which suggest the activation of diaphragm repeat this technique for 10-12 times with 2-3 sets that consists of 10 seconds of stimulus pressure and 10 seconds of rest. We performed this procedure 2 times per day for 3 days.[1.]

Group B:

Group B received Abdominal Co-Contraction

Group B was given co-contraction of the abdomen technique, this procedure produced stretch on the abdominal muscles, first on the contra-lateral side. The therapist applies mild pressure while gripping the patient's pelvis with one hand and their lower ribs with the other, ensuring that the force is given at an angle to the patient. Alternating activation was thought to occur as the pressure was maintained 3 sets were given, 10 reps each with rest time of 1 min.

The post intervention results were noted for both the groups. We performed this procedure 2 times in a day for 3 days.

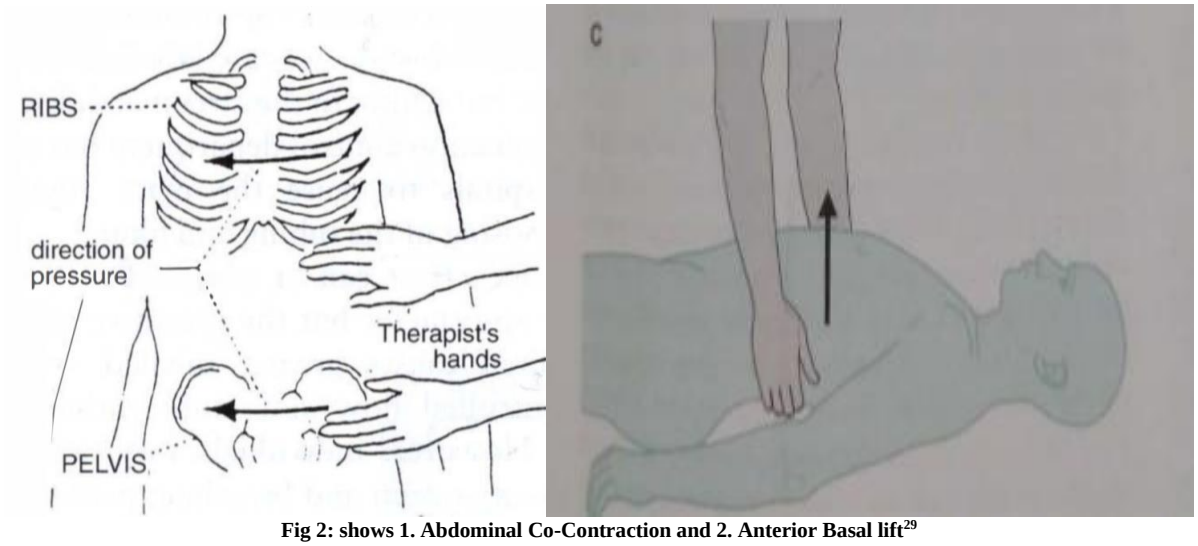


Fig 2: shows 1. Abdominal Co-Contraction and 2. Anterior Basal lift[29]

OUTCOME MEASURES

1. Lung Compliance [ml/cmH_2O]
   a. Static Lung Compliance
   b. Dynamic Lung Compliance
2. Tidal Volume [mL]
3. Respiratory Rate [breaths/min]
4. Heart Rate [beats/min]
5. Saturation of peripheral oxygen [SPO_2]

STATISTICAL ANALYSIS

Descriptive statistical analysis obtained using frequency, percentage, mean, SD, CI, median and IQR. Paired t-test was used for the comparison of Pre and post data within the group. Unpaired t-test was used for the comparison of data between group A and Group B. All the statistical analysis was performed by using IBM SPSS version 29.0.0.

RESULT

Table 1&2 depicts pre post mean and SD values of outcomes in group A & B. Table 3 represent comparison of post-procedure parameters [Mean & SD] of the group A and group B on Day 3 .The mean value of Tidal Volume in Group A was 415.33 ± 39.62 and in Group B was 378.67±18.46. The mean value of Respiratory Rate in Group A was 23.33 ± 0.49 and in Group B was 23.87±0.83. The mean value of Lung Compliance in Group A was 38.81 ± 2.22 Group B was 98.23±0.77. The mean value of Heart Rate in Group A was 119.8 ± 5.18 and in Group B was 124.54±6.93. Statistically significant improvements were observed in both groups but more pronounced in group A [Tidal Volume (t= 3.24) P<0.05, Respiratory Rate (t=2.16) P<0.05, Heart Rate (t=2.06) P<0.05 Lung Compliance (t=7.38) P<0.05, SPO_2 (t=2.50)] compare to group B.

Table 1: Intra Group Comparison Of parameters in group A

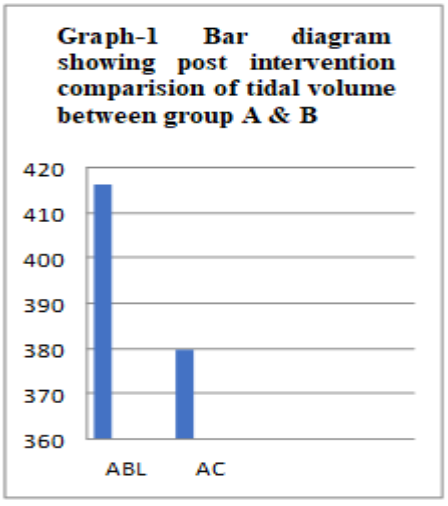
GROUP	PARAMETERS	PRE Mean & SD	POST Mean & SD	t-VALUE	p-VALUE
A	Lung Compliance	27.62±1.85	39.81±2.22	3.01	<0.05
A	Tidal volume	320.07±12.60	416.33±39.62	9.22	<0.05
A	Respiratory rate	26.13±0.83	24.33±0.49	6.87	<0.05
A	Heart rate	124.40±5.52	120.8±5.18	11.14	
A	SPO_2	97.63±0.55	99.87±0.62	7.03	<0.05

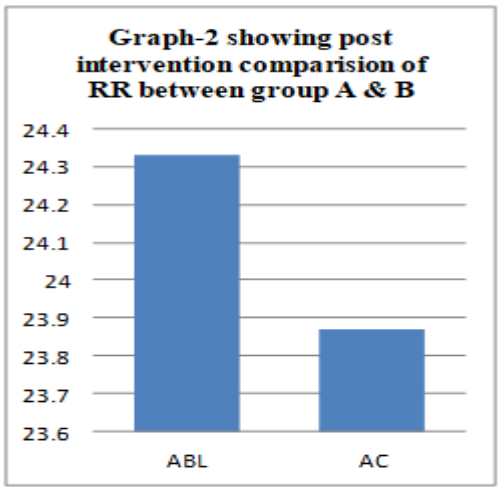
Table 2: Intra Group Comparison of parameters in group B

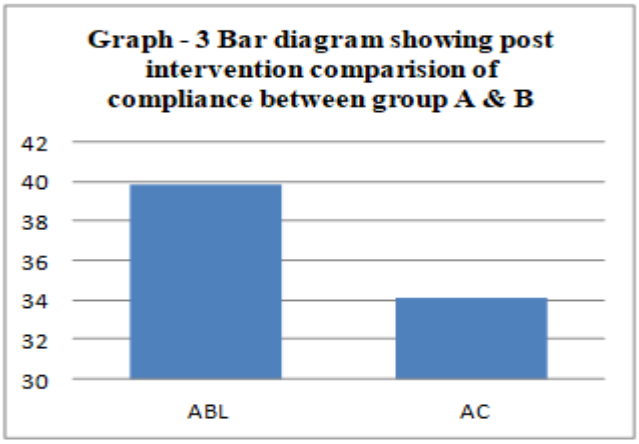
GROUP	PARAMETERS	PRE Mean & SD	POST Mean & SD	t-VALUE	p-VALUE
B	Lung Compliance	26.23±1.81	34.11±2.22	14.66	<0.05
B	Tidal volume	318.27±12.81	379.67±18.46	14.66	<0.05
B	Respiratory rate	27.47±0.99	23.87±0.83	8.41	<0.05
B	Heart rate	124.53±6.51	121.73±6.27	2.09	<0.05
B	SPO_2	95±0.83	97.23±0.77	7.03	<0.05

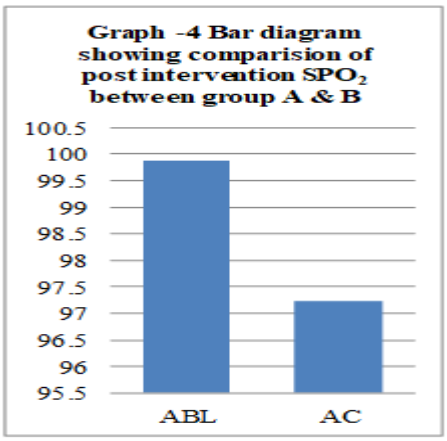
Table 3: Data represent comparison of post-procedure parameters of the group A and group B on Day 3. Student's unpaired t test

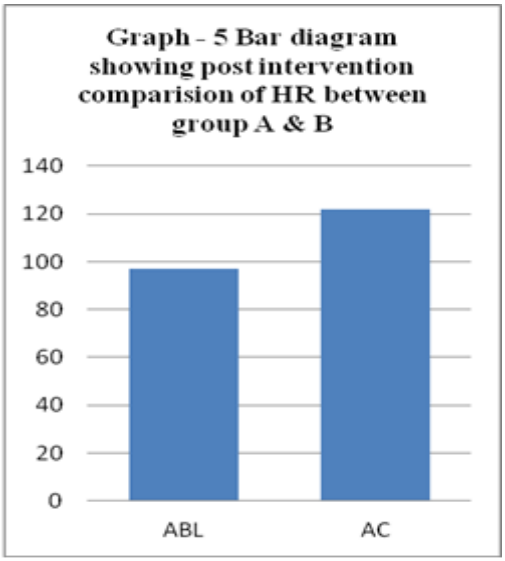
PARAMETERS	GROUP – A Mean & SD	GROUP-B Mean & SD	t- value	p-value
Lung Compliance	39.81±2.22	34.11±2.22	3.24	0.003
Tidal volume	416.33±39.62	379.67±18.46	2.16	0.03
Respiratory rate	24.33±0.49	23.87±0.83	7.38	0.001
Heart rate	120.8±5.18	121.73±6.27	2.50	0.01
SPO_2	99.87±0.62	97.23±0.77	2.06	0.04











DISCUSSION

The current study compared the effects of anterior basal lift and abdominal co-contraction techniques on respiratory rate, heart rate, saturation of peripheral oxygen, tidal volume, and lung compliance parameters. It observed that the neurophysiologic facilitation of respiration in patients has varying effects on these parameters.

The study's findings had been verified by Rajiv Sharma, who examined the effects of resistance training versus proprioceptive neuromuscular facilitation on the respiratory rate of 30 intensive care unit patients. PNF was found to be more effective in reducing respiratory rate in ICU patients compared with abdominal weights applied to the upper abdomen.[15,16]

This study backs up the representations made by Jennifer A. Pryor and N. B. Thakkar (2006) that using the PNF stretch technique in ICU patients has benefits because it lowers elevated RR and HR and raises SPO2 levels within a range that is appropriate for the ventilator weaning process.[17,18]

Nitz J et al. (2002) showed that when myotonic dystrophy patients are weaned off mechanical ventilation, respiratory PNF procedures are applied, which improves respiratory function. This research supports the aforementioned conclusion. [19]

The results of this study support those of Binesh Asokan Poozhikunnath's research into the effect of respiratory PNF in COVID-19 patients, which found that the experimental group significantly outperformed the control group in terms of oxygen saturation and respiratory rate. [20]

Research carried out by Dr. Hardini Prajapati, To evaluate the impact of NPF of respiration on mechanically ventilated patients' ventilation and determine that NPF

of respiration can enhance mechanically ventilated patients' ventilation and supports this research. [21]

In a study by Sandesh P. Londh et al., the authors examined the immediate effects of neurophysiological facilitation and chest manipulation on hemodynamic parameters in patients with ventilator-dependent organophosphorus poisoning. They came to the conclusion that both methods improve hemodynamic parameters.[22]

The research statement by Kumar Jithendra bolsters the findings of this study as well. It suggests that the PNF approach for ICU-based patients improves patient condition by lowering heart and respiratory rates, raising SPO2, and facilitating early weaning off of mechanical ventilation. [23]

Angela Chang et al (2002) provides preliminary evidence of improved short term ventilatory function following PNF techniques.[24]

Research on the impact of respiratory Proprioceptive Neuromuscular Facilitation (PNF) exercises on pulmonary function in the geriatric population conducted by Gopi Parth Mehta et al. (2015) and Dr. Dhara B Desai et al. (2017) revealed that PNF exercise improves pulmonary function in the geriatric population. [25, 26]

Anup Bhat et al. (2014) carried out a survey study to evaluate the state of chest physiotherapy in India's neurological intensive care units. This investigation found that around 85% of physiotherapists used PNF treatments with patients in neurological intensive care units.[27]

Anterior basal lift technique is more effective than vertebral pressure technique in patients on mechanical ventilation, according to a study by Abhinav Salve et al. titled "Effect of Vertebral Pressure Technique and Intercostal Stretch Technique on Respiratory Rate, Tidal Volume, SPO2, and Heart Rate among Organophosphorus Poisoning Patients: An Experimental Study." The study found that both techniques had equal significant differences in patients on mechanical ventilation.[28]

Proprioceptive neuromuscular facilitation (PNF respiration) is a widely established facilitator stimulus to elicit responses to reflex respiratory movement. Airways, lung, and respiratory muscle information from sensory receptors, as well as central and peripheral chemo receptors, regulate respiratory drive. GOT (glutamic oxaloacetic transaminase) is responsible for controlling the contraction and relaxation of the respiratory muscles. It is sensitive to both active and passive muscle stretch, which causes a firing discharge of the muscle spindle.

This signal is then transmitted to the central nervous system (CNS) via Alpha and Gamma motor neurons, which are directly responsible for initiating muscle contraction. The firing release of the muscle spindle during a passive stretch could be the cause of the change in breathing characteristics.

By activating the parasympathetic nervous system, respiratory PNF procedures help lower heart rate and respiratory rate. Methods such as the Thoracic Thrust, Anterior Basal Shift, and Intercostal Stretch improve lung expansion, which in turn improves oxygenation, which aids in ventilation.

Since dorsal root, stretch receptor, and intersegment reflexes mediate most responses to respiratory PNF, there were only minor but statistically significant differences between the two groups.

CONCLUSION

The present study concludes that both respiratory PNF technique [Anterior Basal Lift & Abdominal Co-Contraction] are effective in improving ventilatory parameter in mechanically ventilated patients.

Anterior Basal Lift is more effective in reduction of RR and HR and improving Tidal Volume, Lung Compliance & SPO_2 over Abdominal Co-Contraction technique in mechanically ventilated patients.

Limitation Of The Study

Small sample size and period of intervention used in the present study is small.

Future Scope

Future research with other PNF techniques should be conducted with large sample size and long duration.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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