ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 10 | October - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

THE EFFECT OF NEUROMUSCULAR ELECTRICAL STIMULATION ON RESPIRATORY PARAMETERS, PAIN, AND QUALITY OF LIFE IN INCENTIVE CARE UNIT PATIENTS

Physiotherapy

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ABSTRACT

Background: Critically ill individuals frequently experience intensive care unit acquired weakness (ICUAW), particularly if they are on prolonged mechanical breathing. Neuromuscular electrical stimulation (NMES) has been proposed as an intervention to prevent muscle atrophy and promote recovery in this group. **Objective:** This review aims to synthesize current evidence on the efficacy of NMES in the ICU setting, focusing on its role in muscle preservation, respiratory function improvement, and reduction of mechanical ventilation duration. **Methods:** The effects of NMES on critically sick patients were investigated by a thorough study of systematic reviews, meta-analyses, and clinical trials. Significant studies were chosen from peer-reviewed journals, with an emphasis on results pertaining to overall patient recovery, respiratory muscle strength, and muscle mass retention. **Results:** NMES effectively maintains muscle mass and improves respiratory function in critically ill patients. It benefits those with chronic obstructive pulmonary disease (COPD) and older patients by enhancing muscle strength and shortening mechanical ventilation duration. Combining NMES with early rehabilitation can further improve outcomes.

KEYWORDS

INTRODUCTION

In the ICU, NMES helps counteract severe muscle weakness caused by immobility, mechanical ventilation, and inflammation. This muscle loss can worsen breathing difficulties, increase pain, and extend ICU stays.[1]

In the ICU, NMES is a promising therapy for muscle weakness, respiratory failure, and pain, which are worsened by immobility and inflammation.[2]

Respiratory Muscle Weakness:

In the ICU, muscle weakness and respiratory dysfunction from long-term ventilation and immobility can prolong ICU stays.[1] NMES improves respiratory muscle strength and endurance, potentially reducing mechanical ventilation needs and enhancing pulmonary outcomes.[2,3] NMES significantly increased respiratory muscle strength in chronic respiratory failure patients, indicating its potential ICU use.

Pain Management:

In the ICU, NMES may improve pain management by inducing muscle contractions to activate natural pain relief and reduce spasms.[4] NMES influences pain perception and has shown promise in reducing pain and improving comfort in ICU patients.[4]

Quality of Life:

Neuromuscular Electrical Stimulation (NMES) helps reduce pain, strengthen muscles, and improve mobility in ICU patients, leading to faster recovery and better rehabilitation outcomes. Studies show that NMES enhances functional recovery, reduces the effects of critical illness, and improves patient satisfaction.[2]

METHOD

Authors, Journal, Year	Design	Material and Methods	Outcomes Measures	Results
Dilek KK et al. (2015)61: 12-7	Experimental study deign	Thirty stage 4 COPD patients were split into two groups. Both did upper extremity exercises, but one also received NMES. Measurements were taken on days 1, 8, 15, and 30.	Arterial blood gas, peak heart rate, breathing frequency, SGRQ, SF-36, and FIM were used to assess health outcomes and functional capacity.	This study revealed positive effects of neuromuscular electrical stimulation in addition with therapeutic exercises on the cardio respiratory system in the short run.
Francisco Valdez et at. (2018)	randomized double-blind trial deign	Participants were randomly assigned to NMES, exercise, NMES + exercise, or standard care within 24 hours of ICU admission. The main endpoint was MV duration, and intention-to-treat analysis was used.	Primary Outcome: Duration of mechanical ventilation. Secondary Outcomes: ICU length of stay, weaning success, ventilator complications, muscle strength, physical function (ICU Mobility Scale), and post-discharge quality of life.	NMES + EX consisting of NMES and active EXs was well tolerated and resulted in shorter duration of MV in comparison to standard care or isolated therapy (NMES or EX alone).
Ying Liu et al. (2023) 23:272	Prospective randomized controlled study deign	In this study, 80 ventilated patients were randomly assigned to NMES + early rehabilitation or early rehabilitation alone. Muscle metrics were measured by ultrasound at various points during and after the intervention.	Muscle mass and strength, duration of mechanical ventilation, ICU length of stay, ICU-acquired weakness, and functional status at discharge.	NMES with early rehabilitation reduces muscle atrophy and improves strength in ventilated patients, but more research is needed.
Om Elhaa naa et al. (2019)7,16	Quasi –experimental research design.	the researcher assessed ICUAMW, muscle strength and mortality rate.	level of muscle strength and intensive care unit acquired weakness (ICUAW) by using MRC,	Application of neuromuscular electrical stimulation nursing application had opposite effect on MV Patients out

			muscle function by using muscle function assessment scale, the duration of mechanical ventilation and the length of stay in the intensive car unites, mortality rate by assessing number of dead cases.	comes.
Ana M et al. (2017)49: 40–48	double-blind study, randomized controlled trail (RCT)	Patients on mechanical ventilation for 24–48 h were randomized to an intervention group (neuromuscular electrical stimulation + conventional physical therapy) or a conventional group (sham neuromuscular electrical stimulation + conventional physical therapy).	Primary outcome was thickness of the rectus abdominals and chest muscles, determined on cross-sectional ultrasound images before and after the intervention.	There was no change in rectus abdominals and chest muscle thickness in the intervention group. A significant decrease was found in these measures in the conventional group.
Cuiping Xu et al. (2024) 24:56	a systematic review and network meta-analysis deign	A search in major databases up to December 24, 2023, identified RCTs comparing NMES with physical therapy or standard ICU care. A network meta-analysis was performed using Stata 14.0 and R 4.3.1.	Encompassing ventilation duration, extubation success rate, ICU LOS, ICU or hospital mortality	NMES combined with physical therapy improves extubation success and clinical outcomes more effectively than standard ICU care or NMES alone, making it a superior rehabilitation strategy.
Marcela et al. (2018) 8	prospective, randomized pilot study deign	Sixty-seven subjects in MV were included, divided into 3 groups: (a) control group (CG, n =26), (b) stimulation of quadriceps (quadriceps group–QG, n = 24), and (c) stimulation of diaphragm (diaphragm group–DG, n= 17).)e QG and DG patients received consecutive daily electrical stimulation sessions at specific points from the first day of randomization until ICU discharge.	Respiratory and peripheral muscle strength, MV time, length of hospitalization, and functional independence score (the Functional Status Score-ICU)	Electrical stimulation of quadriceps had best outcomes for peripheral muscle strength compared with controls or electrical stimulation of diaphragm among mechanically ventilated critically ill subjects and promoted functional independence and decreased length of hospitalization.
Anshu et. al	Experimental Study	The study involved 50 patients (8	The objective of the study was to	The results showed no significant
(2023) 13		females, 42 males, aged 40-75), divided equally into two groups. Group 1 used a volume incentive spirometer with conventional therapy (ACBT and deep breathing exercises), while Group 2 used a flow incentive spirometer with the same therapy. Evaluations were conducted at baseline, post-operative day 2, day 7, and at a 1-month follow-up. The parameters assessed included PEFR, SpO_2, chest expansion, and quality of life (QOL).	compare the effects of volume and flow incentive spirometers on PEFR, SpO_2, chest expansion, and quality of life in patients undergoing CABG surgery.	differences in age, BMI, or smoking history, but a gender difference was noted. Both groups significantly improved PEFR, SpO_2, chest expansion, and QOL by post-OP day 7, with further QOL improvements at the 1-month follow-up.

DISCUSSION

Dilek et al. (2015) found that combining neuromuscular electrical stimulation with exercise significantly improved heart rate, breathing frequency, and functional independence in the short term. Francisco et al. (2018) found that a 55-minute NMES plus exercise session, including warm-up and recovery, was well tolerated and reduced mechanical ventilation duration compared to NMES, exercise alone, or standard care. Ying et al. (2023) showed that NMES combined with early rehabilitation reduced muscle atrophy and improved muscle strength in mechanically ventilated patients, offering a new treatment option. Martha et al. (2018) noted that NMES is promising for ICU-related muscle weakness but calls for earlier detection and thorough evaluation of new rehabilitation methods. Ana et al. (2017) found no muscle thickness change in the intervention group, but a significant decrease in the conventional group. Marcela et al. (2018) found that quadriceps electrical stimulation improved muscle strength, functional independence, and reduced hospitalization in ventilated patients.

CONCLUSION

Overall, the reviewed studies provide valuable insights into the effect of neuromuscular electrical stimulation on respiratory parameters, pain and quality of life in incentive care unit patients.

REFERENCES

1. González A, Abrigo J, Achiardi O, Simon F, Cabello-Verrugio C. Intensive care unit-acquired weakness: A review from molecular mechanisms to its impact in COVID-2019. European Journal of Translational Myology. 2022 Sep 9;32(3).
2. Zayed Y, Kheiri B, Barbarawi M, Chahine A, Rashdan L, Chintalapati S, Bachuwa G, Al-Sanouri I. Effects of neuromuscular electrical stimulation in critically ill patients: a systematic review and meta-analysis of randomised controlled trials. Australian Critical Care. 2020 Mar 1;33(2):203-10.
3. Nussbaum EL, Houghton P, Anthony J, Rennie S, Shay BL, Hoens AM. Neuromuscular electrical stimulation for treatment of muscle impairment: critical review and recommendations for clinical practice. Physiotherapy Canada. 2017;69(5):1-76.
4. Liu Y, Gong Y, Zhang C, Meng P, Gai Y, Han X, Yuan Z, Xing J, Dong Z. Effect of neuromuscular electrical stimulation combined with early rehabilitation therapy on mechanically ventilated patients: a prospective randomized controlled study. BMC pulmonary medicine. 2023 Jul 21;23(1):272.
5. KURTOĞLU DK, TAŞTEKİN N, Birtane M, TABAKOĞLU E, SÜT N. Effectiveness of Neuromuscular Electrical Stimulation on Auxiliary Respiratory Muscles in Patients with Chronic Obstructive Pulmonary Disease Treated in the Intensive Care Unit. Turkish Journal of Physical Medicine & Rehabilitation/Turkiye Fiziksel Tip ve Rehabilitasyon Dergisi. 2015 Mar 1;61(1).
6. Dos Santos FV, Cipriano Jr G, Vieira L, Chiappa AM, Cipriano GB, Vieira P, Zago JG, Castilhos M, da Silva ML, Chiappa GR. Neuromuscular electrical stimulation combined with exercise decreases duration of mechanical ventilation in ICU patients: a randomized controlled trial. Physiotherapy theory and practice. 2020 May 3.
7. Kusumawardani MK, Poerwandari D, Narasinta I, Hidayati HB, Subadi I. The role of neuromuscular electrical stimulation for rehabilitation in ICU acquired weakness. Anaesthesia, Pain & Intensive Care. 2018:S164-9.
8. Mohamed OE, Shehata AE, Mohamed M, Khalaf GS. The Effect Of Nursing Application Of Neuromuscular Electrical Stimulation on Mechanically Ventilated Patient's Outcome. Assiut Scientific Nursing Journal. 2019 Mar 1;7(16):80-90.
9. Dall'Acqua AM, Sachetti A, Santos LJ, Lemos FD, Bianchi T, Naue WD, Dias AS, Sbruzzi G, Vieira SR. Use of neuromuscular electrical stimulation to preserve the thickness of abdominal and chest muscles of critically ill patients: a randomized clinical trial. Journal of rehabilitation medicine. Uppsala. Vol. 49, n. 1 (Jan. 2017), p. 40-48. 2017.

10. Xu C, Yang F, Wang Q, Gao W. Effect of neuromuscular electrical stimulation in critically ill adults with mechanical ventilation: a systematic review and network meta-analysis. BMC Pulmonary Medicine. 2024 Jan 25;24(1):56.
11. Liu M, Luo J, Zhou J, Zhu X. Intervention effect of neuromuscular electrical stimulation on ICU acquired weakness: a meta-analysis. International journal of nursing sciences. 2020 Apr 10;7(2):228-37.
12. Nussbaum EL, Houghton P, Anthony J, Rennie S, Shay BL, Hoens AM. Neuromuscular electrical stimulation for treatment of muscle impairment: critical review and recommendations for clinical practice. Physiotherapy Canada. 2017;69(5):1-76.
13. Nonoyama T, Shigemi H, Kubota M, Matsumine A, Shigemi K, Ishizuka T. Neuromuscular electrical stimulation in the intensive care unit prevents muscle atrophy in critically ill older patients: A retrospective cohort study. Medicine. 2022 Aug 5;101(31):e29451.
14. Kumari A, Choudhry D, Lohchab S, Sikka G, Baberwal M, Jhandai M, Kumar P. Comparison of effects of volume incentive spirometer and flow incentive spirometer on peak expiratory flow rate, oxygen saturation, chest expansion, and quality of life in patients undergoing CABG surgery: an experimental study. J Cardiovasc Disease Res. 2023;14(12):3087-3094.