Neuromuscular Electrical Stimulation Applied to the Abdominal Muscles to Assist Ventilator Weaning in Critically Ill Patients: An Assessor Blinded, Randomized, Sham-Controlled Pilot Study

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Rationale: Intensive care unit (ICU) acquired weakness affects the respiratory and peripheral muscles and is associated with prolonged duration of mechanical ventilation. However, many critically ill patients are sedated or cognitively impaired and cannot participate in traditional respiratory muscle training. The aim of this pilot study was to investigate the feasibility of using neuromuscular electrical stimulation applied to the abdominal wall muscles during exhalation to prevent abdominal muscle atrophy in mechanically ventilated critically ill patients. Methods: Twenty critically ill, adult, patients who were expected to require mechanical ventilation for more than 24 hours were randomly assigned to receive either active or sham (control) stimulation. Stimulation was delivered over two 30-minute sessions per day, 5 days per week until ICU discharge. Abdominal muscle and diaphragm thickness were measured using ultrasound 3 times in the first week and weekly thereafter. Maximum respiratory pressures and spirometry were measured on the first day the patient was able. Ventilator duration and ICU length of stay were recorded at ICU discharge. Results: All participants tolerated stimulation and on average completed 93.6% ± 6.0% (mean ± standard deviation) of the planned stimulation sessions. There was no significant longitudinal difference in the change in thickness of the rectus abdominis (P = 0.594), diaphragm (P = 0.888) and combined lateral posterior abdominal muscles (P = 0.080) between groups. Ventilation duration (median survival 6.5 days versus 34 days, P = 0.039) and ICU length of stay (median survival 11 days versus non-estimable days, P = 0.011) were shorter in the active compared to the control group. There were 10 adverse events in the active group and 22 in the control group, and two serious adverse events in the active group and eight in the control. An independent safety monitoring committee determined that none of the serious adverse events were related to the intervention. Conclusions: It is feasible to apply neuromuscular electrical stimulation to the abdominal muscles in critically ill patients. The results of this pilot study indicate that it may be an effective strategy in reducing ventilation duration and ICU length of stay, and justify a fully powered follow-up study. Support: Liberate Medical, National Science Foundation (Grant No. 1632402), Kentucky Cabinet for Economic Development, the National Health and Medical Research Council (NHMRC), The Prince of Wales Hospital Foundation (POWHF) and The Australian Academy of Technological Sciences

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