# Perioperative Neuromuscular Electrical Stimulation: For the Vulnerable Cardiac Surgery Patient? Or Is There More Bang for Your Buck With Exercise Training?

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It is imperative to preserve skeletal muscle mass and function for the increasingly older and frail patient requiring cardiac surgery to improve their prognosis.[1] However, it is inevitable for surgical patients to undergo long periods of immobilization in the intensive care unit, where muscle wasting is a concern.[2,3]

In this issue of the Journal are the findings from Kitamura et al, who pilot tested a perioperative neuromuscular electrical stimulation (NMES) intervention to attenuate muscle wasting, measured by the muscle proteolytic marker 3-methylhistidine (corrected for urinary creatinine), and to preserve lower extremity strength following cardiac surgery. All patients in the control and intervention group received postoperative mobilization and an aerobic and resistance exercise program. The intervention group also received perioperative NMES initiated 3 days prior to surgery and daily, up to 5 days following surgery. Discouragingly, their pilot study did not detect a statistically significant difference between the intervention and control group for these outcomes.

Despite the null findings, this is a well-designed pilot study. The authors have carefully planned their recruitment and successfully blinded data collection and outcome assessment. Furthermore, the authors have recruited a large sample size for their pilot study, which enables them to obtain a robust sample size estimate for a future clinical trial.

Further investigation into the utility of perioperative NMES in the cardiac surgery patient is needed. Indeed, this approach may prove useful among the very frail who are limited in their ability to perform activities of daily living prior to their operation. Targeting a more vulnerable patient population may be warranted, as there is a high proportion of patients who are frail prior to cardiac surgery and are at an increased risk for adverse events following cardiac surgery.[4,5]

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**Central Message**

Perioperative neuromuscular electrical stimulation did not mitigate muscle wasting or preserve strength. Preoperative aerobic or resistance exercise may be needed to elicit change.

In the study by Kitamura et al, the dose of NMES may not have been sufficient to elicit positive changes in muscle wasting or strength. Recommendations regarding the volume of NMES range significantly, but it is suggested that the intensity (% of maximum voluntary contraction) of NMES should range from 25% to 50% to stimulate muscle hypertrophy.[6] However, Kitamura et al used an upper value of 20% of a patient's maximum voluntary contraction, as they have found patients cannot tolerate onset muscle soreness with higher values. Even so, it may have been worthwhile to gradually increase contractions to a higher limit when the participants could tolerate a higher intensity. Furthermore, higher volumes of NMES, lasting multiple times per day, may have been needed to derive benefit.

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Initiating NMES earlier in the preoperative period also enable a longer intervention period that could stimulate muscle hypertrophy and strength prior to surgery.

NMES may not be as effective as aerobic and resistance exercise training to preserve skeletal muscle mass and strength. Implementing the usual care aerobic and resistance training regimen that was delivered as a part of standard care in the preoperative period may have evoked changes in their primary outcomes. Indeed, there is evidence that an active lifestyle preoperatively may reduce the risk of postoperative adverse events,[7] and clinical trials have demonstrated the efficacy of preoperative aerobic exercise training to improve hospital and functional outcomes, with a larger ongoing trial that will confirm its efficacy in older patients.[8–10]

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