Efficacy of neuromuscular electro stimulation on muscle strength in elderly patients with diabetes mellitus underwent cardiovascular surgery – a multicenter randomized controlled trial

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Introduction: Cardiovascular surgery causes muscle weakness probably due to a postoperative increase in inflammatory cytokine production, and diabetes mellitus (DM) may promote the postoperative muscle weakness because of increased insulin resistance.

Purpose: A multicenter randomized controlled trial was conducted to examine the effects of postoperative neuromuscular electrical stimulation (NMES) on muscle strength for elderly patients with DM after cardiovascular surgery (UMIN000029940).

Methods: Patients underwent cardiovascular surgery were consecutive screened for eligibility (With DM and age $\geq$65 years) as study subjects. If eligible, patients were randomly assigned either to the NMES or the sham group. Both of group underwent NMES or sham stimulation (60 minutes / 5 times) and usual postoperative early mobilization program until postoperative day (POD) 7. The primary outcome was the percent change in knee extensor isometric muscle strength (%ΔKEIS) between preoperative to POD 7. Secondary outcomes were the percent change in usual (%ΔUsual walking speed) and maximum walking speed (%ΔMaximum walking speed) and grip strength (%ΔGS). Assessors for physical function were blinded to the outcomes. The statistician who was blinded to the allocation analyzed the data using preoperative value adjusted ANCOVA.

Results: Of 1151 consecutive patients screened for eligibility from February 2018 to January 2020, 158 participants (NMES group, n=79; sham group, n=79) were enrolled. NMES group demonstrated significantly lower %ΔKEIS compared with those in the sham group (Table). Among secondary outcomes, NMES group showed significantly lower %ΔMaximum walking speed and tendency of lower %ΔUsual walking speed and %ΔGS (Table).

Conclusion: NMES prevented postoperative muscle weakness in the elderly patients with DM, indicating that NMES along with early mobilization could be implicated as specific intervention to those populations.

Table 1. Estimates of effect in primary and secondary outcomes in NMES and sham group

Outcome	N	NMES group (n=79)		Sham group (n=79)		P
		Adjusted Means	95% CI	Adjusted Means	95% CI	
% ΔKEIS	158	−2.3	−5.7 to 1.1	−13.7	−17.1 to −10.3	<.0001
% ΔUsual Waking Speed	158	−12.4	−16.3 to − 8.5	−17.4	−21.3 to −13.5	0.078
% ΔMaximum Waking Speed	156	−12.9	−17.1 to − 8.7	−20.1	−24.2 to −16.0	0.016
% ΔGS	158	−8.3	−11.1 to −5.6	−12.1	−14.8 to −9.3	0.06

Adjusted for preoperative value. Abbreviations: The percent change in knee extensor isometric strength (% ΔKEIS), usual waking speed (% ΔUsual Waking Speed) and maximum waking speed (% ΔMaximum Waking Speed), grip strength (% ΔGS) from preoperative to postoperative day 7.