Early Poststroke Rehabilitation Using a Robotic Tilt-Table Stepper and Functional Electrical Stimulation

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ABSTRACT

Objective: Neither for the Erigo nor FES therapy, safety, feasibility, and efficacy have been demonstrated in patients during the acute phase after stroke. The objective of this study was to assess safety - especially with respect to orthostatic reactions - of Erigo assisted verticalization with and without FES shortly after a stroke. Another aim was to conduct a preliminary assessment of efficacy.

Participants 104 patients suffering from ischemic stroke in the territory of the middle cerebral artery not longer than 7 days before enrolment participated in the trial. Patients with hemiparesis 4 or fewer points on the MRC scale were included.

Intervention: Patients were randomly assigned to the following groups: Tilt table verticalization, Erigo training or Erigo and FES. Patients received 20 to 30 minutes of training daily over a period of 30 days in combination with conventional physiotherapy. During the first three training sessions patients receiving Erigo training were gradually verticalize from 10 to 30 degrees, and stepping was performed at a rate of 38–40 steps per minute. Loading of the legs was either passive or passive-active. By session 5, verticalization was then increased to 60 degrees and stepping to 40–56 steps per minute. By session 24, verticalization was further increased to 80 degrees as tolerated by the patient. The control group was moved in vertical position on the tilt table using an identical protocol except that no stepping or FES was performed. The Erigo and FES group received additional FES using a 6 channel stimulator. Electrodes were placed over biceps femoris, quadriceps femoris and gastrocnemius of either leg. The stimulation was synchronized with robotic leg movements: biceps femoris, and gastrocnemius muscles were stimulated at the time of leg flexion; quadriceps femoris was stimulated at the time of leg extension. Strength of stimulation varied between 5 and 100mA.

Main Outcome Measures: Impedance cardiography and transcranial doppler sonography were performed before, during, and after training. Hemiparesis was assessed using the British Medical Research Council (MRC) strength scale.

Results: No serious adverse events occurred; 8 patients in the tilt-table group prematurely quit the study because of orthostatic reactions. Blood pressure and CBFV dipped < 10% during Erigo training. In 52% of controls mean arterial pressure decreased by ≥ 20%. Erigo and FES increased leg strength by 1.97 ± 0.88 points, Erigo by 1.50 ± 0.85 more than tilt table only (1.03 ± 0.61, \( P < 0.05 \)). CBFV increased in both Erigo groups more than in controls (\( P < 0.05 \)).

Conclusions: Robotic tilt-table exercise with or without FES is safe and may be more effective in improving leg strength and cerebral blood flow than tilt table alone.

Paper Reference:

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