PhD-project: Early therapeutic management of the affected arm functioning after stroke: prediction and intervention

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ABSTRACT

Background: Arm paresis is present in 48–77% of acute stroke patients. Complete functional recovery is reported in only 12–34%. Although the arm recovery is most pronounced during the first 4 weeks post-stroke, few studies examined the effect of upper extremity interventions during this period. To be applicable in clinical practice, prognosis of arm recovery needs to be based on easy-to-perform, meaningful measures. Several clinical tests have been proposed for prognosis of arm functioning after stroke; further validation of their predictive value is needed.

Objectives: a) To investigate the effect of electrical somatosensory stimulation (ESS) delivered during early stroke rehabilitation on the recovery of arm functioning; b) to examine the individual predictive value of easy-to-perform clinical tests for early prognosis of arm functioning.

Methods: 102 patients with arm paresis were randomized to an intervention or a control group within 7 days post-stroke according to our sample-size estimation. The intervention group received 1-hour ESS to the paretic arm daily during hospitalization immediately followed by minimum 15-minute task-oriented arm training that was considered a component of the usual rehabilitation. The control group received a placebo ESS followed by identical training. Primary outcome: Box and Block Test (BBT); secondary outcomes: upper extremity section of Fugl-Meyer Assessment, subscale A–D (FMA-UE-AD), grip strength, pinch strength, perceptual threshold of touch, pain and modified Rankin Scale (mRS); all recorded at baseline, post-intervention and at 6 months post-stroke. Furthermore, the following variables measured 3–7 days post-stroke using FMA-UE were considered potential predictors of FMA-UE-AD at 6 months post-stroke: shoulder abduction and elbow extension within synergies, forearm pronation/supination, wrist dorsiflexion, mass finger extension, grasping ability, and sensory function. Based on merged data from two independent studies (n=223), logistic regression was used for each predictor to calculate the odds ratio of two levels of arm functioning: FMA-UE-AD ≥32 and ≥58.

Results: There were no differences between the intervention and the control groups for any outcome measures at any time points. Clinically significant improvements were observed for FMA-UE-AD, hand grip strength and mRS in both groups. Moreover, patients with initial partial shoulder abduction were at least 7.3 times more likely to achieve a FMA-UE-AD≥32 at 6 months post-stroke. The probability of a FMA-UE-AD≥58 was at least 3.3−35.2 times higher in patients with partial/full distal movement (forearm pronation/supination, wrist dorsiflexion and grasping ability) compared with patients with absent movement. Patients with full elbow and mass finger extension
were at least 36.8 and 18.3, respectively, times more likely to achieve a FMA-UE-AD≥58 than those with no movement. Full sensory function had a significant but more modest predictive value.

**Conclusions:** The data show that the present ESS-protocol prior to arm training was equally beneficial as arm training alone. These results apply for patients with mild-to-moderate stroke and moderate arm impairments. It cannot be excluded that patients with other characteristics, during other time intervals post-stroke or using a different ESS-protocol might benefit. Furthermore, this thesis confirmed that sufficient sensory function and some proximal/distal arm movement early post-stroke predict a better arm functioning at 6 months in patients with same characteristics; partial/full distal movement was identified as a predictor of a FMA-UE-AD≥58 at 6 months post-stroke.

**Key words:** Acute stroke, arm paresis, electrical somatosensory stimulation, early rehabilitation, recovery of arm functioning, prediction.