USING ROBOTIC TECHNOLOGY TO QUANTIFY NEUROLOGICAL RECOVERY IN APPARENT HIGH FUNCTIONING SURVIVORS OF CARDIAC ARREST: A PILOT STUDY

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Introduction: Neurologic outcome after cardiac arrest remains poorly defined, with most studies using 5-point rating scales, such as the Cerebral Performance Category (CPC). These rating scales do not provide the granular data necessary to examine the efficacy of modern neuroprotective strategies to improve neurological recovery after cardiac arrest. The KINARM Robot (BKIN Technologies, Canada) provides quantitative metrics of sensorimotor and neurocognitive function. This tool has been used to demonstrate subtle neurological deficits in stroke patients not identified by routine neurological testing. Importantly, these subtle deficits correlated well with quality of life metrics (Coderre et al., 2010).

Objectives: The primary objective of this study was to demonstrate the feasibility of using robotic technology to provide a quantitative definition of neurological function among survivors of cardiac arrest.

Methods: We recruited survivors of cardiac arrest who were all treated with targeted temperature management in our 33-bed medical-surgical ICU. The KINARM end-point device was used to quantify performance on several tasks unique to the robot, including: arm reaching, position matching (proprioception), object hit/hit and avoid (visuomotor and executive), and spatial span (working memory). Subjects also performed an automated version of the Trails A and Trails B test to assess set shifting. Subject performance was compared to a large normative database, thus Z-scores were available for most tasks performed. Additionally, subject performance was compared to the performance of patients awaiting coronary artery bypass surgery who served as an active control group.

Results: This pilot study has recruited 14 (6 post cardiac arrest, 8 active controls) patients. All cardiac arrest subjects would be traditionally defined as having a good neurological recovery according to their CPC at the time of testing (5 were CPC 1-normal; 1 was CPC-2-moderate neurological disability). The mean age of subjects was 49 (range 19-71). They were assessed 1-24 months after cardiac arrest. The active control group was significantly older (mean 68, p = 0.03), limiting direct comparisons between groups. For some of the tasks that z-scores were available, we noted that these apparent high-functioning survivors of cardiac arrest scored outside the normal range (defined as z-score +/- 1.5). For example, 2 of 6 cardiac arrest subjects had performance outside the normal range for maximum speed of arm reaching and errors on a limb-matching (proprioception) task. None of the active controls performed abnormally on these tasks.

Conclusion: We have established the infrastructure necessary, and have demonstrated the feasibility of using robotic technology to quantify neurological function in high functioning survivors of cardiac arrest. We are currently enrolling patients into a larger study in order to build a precise and quantitative definition of the spectrum of neurological recovery after cardiac arrest.