AIS: Augmented intelligence in stroke therapy

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Background: The development of personalized patient care requires consideration of many factors that affect outcomes. Using biomarkers derived from clinical data helps achieve this. These biomarkers aid in precise diagnosis, patient selection for trials, disease monitoring and finding new treatment targets.

Biomarkers in that sense are also indicators of disease that have predictive potential in terms of recovery or response to a particular treatment [2]. In recent years, prognostic biomarkers have been identified and their integration in stroke rehabilitation has emerged as a stratification and identification method for factors that influence the recovery process [1]. It has been demonstrated that neurophysiological biomarkers possess the greatest predictive potential. These include the responses to transcranial magnetic stimulation (TMS) and magnetic resonance imaging (MRI) for visualization of the corticospinal tracts [2].

While some patients recover fast after a stroke and can return quickly to their everyday lives, others develop spasticity or hemiparesis and have problems returning to their normal lives. We know by now, that the patients' personal motivation, but also the area of damaged brain areas and the size of the stroke play an important role for a successful post-stroke recovery.

The precision in predicting post-stroke recovery not only facilitates the formulation of effective rehabilitation plans, but also helps in establishing realistic and attainable rehabilitation goals. The challenge lies in selecting suitable biomarkers with high sensitivity and specificity from numerous variables that influence clinical outcomes [3].

Despite the growing use of robotic therapy devices in stroke rehabilitation, the predictive potential of data recorded during these therapies has only been studied to a limited extent. However, the automated and objective collection of prediction data by robots could improve accuracy and comparability.

The AIS (=Augmented intelligence in stroke therapy) project aims to collect data from a robotic gait therapy device and assess the suitability of this data for predicting recovery of walking ability after a stroke. The investigation explores the untapped potential of robotic therapy data as a source of possible predictive biomarkers in the context of stroke rehabilitation.

Methodology: This study is a diagnostic monocentric investigation focusing on post-stroke patients unable to walk, characterized by a Functional Ambulation Category (FAC) score of less than 2. The study duration for each participant spans three weeks, starting within 14 days of admission.

Utilizing the robotic therapy device VEMOTION (Reactive Robotics, Germany), patients are verticalized directly in their beds, while their legs are moved passively or actively to stimulate the motions of physiological walking (Functional Ambulation Category). The data for possible biomarkers is collected with device integrated pressure-, movement- and accelerometer sensors and a smart watch that the patient wears during the therapy sessions. It is to find out whether some of these parameters correlate with recovery after a stroke and are suitable biomarkers for predicting post-stroke motor recovery.

Hypothesis and Aim: It is hypothesised that combining clinical data (e.g. National Institutes of Health Stroke Scale, Medical Research Council Scale, MRI, Trunk control test, Berg balance scale, Barthel Index) with input from the robotic therapy device (e.g. acceleration, force adaptation, amount of steps per minute, verticalization) can predict the accuracy of walking recovery after a stroke.

The overall aim is to identify and systematize predictions related to motor recovery in the lower limbs following a stroke for the first time.

The primary objective is to assess whether this combined dataset of clinical and device related data facilitates an accurate prognosis for post-stroke recovery, with a focus on the restoration of independent walking. Secondarily, it is examined how and how fast patients' behaviour in terms of gait pattern adapt to mild counterforces, such as a reduction in walking speed, during robotic-assisted therapy. This could also be a suitable biomarker for predicting motor recovery.

The project also fosters collaboration between robotics experts, physicians, nurses and therapists by incorporating the support of artificial intelligence and facilitating interaction between humans and machines.

Outlook: Currently the study encompasses six participating patients. The aim is to gather data from a total of 10 post-stroke patients who are unable to walk.

References:

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