Journal of Bodywork & Movement Therapies (2014) 18, 412–423

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/jbmt

STROKE OUTCOME MEASURE: CRITICAL REVIEW

Stroke-related motor outcome measures: Do they quantify the neurophysiological aspects of upper extremity recovery?

Shanta Pandian, Superintendent OT (OPD), MOT (Neuro.) , Kamal Narayan Arya, Sr. Occupational Therapist, MOT, PhD*

Pandit Deen Dayal Upadhaya Institute for the Physically Handicapped (University of Delhi), Ministry of Social Justice and Empowerment, Govt. of India, 4 VD Marg, New Delhi 110002, India

Received 24 August 2013; received in revised form 23 October 2013; accepted 31 October 2013

KEYWORDS
Brunnstrom recovery stages;
Fugl–Meyer Assessment;
Hemiparesis;
Motor recovery;
Outcome measures;
Stroke rehabilitation;
Upper extremity

Summary Various stroke rehabilitation outcome measures are used in clinical and research practice. Severe upper extremity paresis serves as a challenge for the selection of an appropriate outcome measure. No single measure is universally acceptable and sufficient to record the minute clinically important changes. The objectives of the present review were to explore the stroke-specific upper extremity motor outcome measures and to better understand those measures' ability to quantify upper extremity motor recovery. Seven outcome measures were selected for this review. The criteria used to select outcome measures for this review included performance-based tools that assessed the upper extremity's voluntary motor control and outcome measures which had been used for the past 10 years. A critical review that referred to motor recovery stages and volitional control was performed. The upper extremity components of each measure were compared with the neurophysiological aspects of recovery (Brunnstrom Recovery Stages) and analyzed for their clinical relevance. The concepts of minimal detectable change and minimal clinically important difference were also considered while examining the outcome measures. The findings of this review reveal that there were very few measures available to precisely assess the upper extremity motor components and volitional control. Most of the measures are functional and performance-based. Only Fugl–Meyer Assessment was found to explore the individual joint motor control as per the sequential recovery stages. Further, there is a need to develop stroke-specific upper extremity outcome measures. Scoring criteria of the acceptable measures may be modified to discern precise and progressive, but clinically significant motor changes.

* Corresponding author.
E-mail address: kamalnarya@yahoo.com (K.N. Arya).

1360-8592/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jbmt.2013.11.006

Introduction

Motor assessment and rehabilitation has always been a challenge in post-stroke hemiparesis. Motor deficits such as muscle weakness, abnormal synergy, and spasticity are commonly assessed among stroke subjects. Recovery occurs rapidly in the lower extremity compared with the upper extremity and the hand. Motor recovery in the upper extremity is a slow and continuous process. In spite of clinically observable changes, it is difficult to quantify the upper extremity recovery at a particular point of time. In addition, severity of paresis, poor recovery, complex movement demands and associated complications interfere with the upper extremity motor assessment (Alt Murphy et al., 2011; Carey et al., 2002).

Only 38 percent of stroke clients regain hand functions and fulfill their daily tasks. Even with advanced rehabilitation techniques 11.6 percent of stroke clients achieve functional independence (O'Sullivan and Schmitz, 2007). An evaluation of even small motor changes is very essential to select and provide a specific motor rehabilitation approach. Since years, various assessment methods have been used in clinical and research practice. However, their reliability, validity and sensitivity have always been a point of research. It is also evident that no single measure is universally acceptable and appropriate to capture the precise as well as clinically significant changes (Baker et al., 2011; J. H. Lin et al., 2009; Lin et al., 2010).

The objective of the present study was to review the stroke-specific motor assessment tools and to understand their ability to precisely quantify upper extremity motor recovery. The upper extremity movement components of the selected tools were analyzed in the context of post-stroke hemiparetic recovery.

Inclusion criteria for selection of outcome measures

Outcome measures that were stroke-specific, performance based, assessed the motor behavior and volitional control, evaluated the upper extremity components or had the subsection for upper extremity and were commonly used in the past 10 years in clinical and research practice were included in the study (Baker et al., 2011). Measures that assessed quality of life and functional independence were excluded from the study.

In the present study, on the basis of the inclusion criteria seven assessment tools were selected for the review. The selected measures were Fugl—Meyer Assessment (FMA), Action Research Arm Test (ARAT), Motor Assessment Scale (MAS), Wolf Motor Function Test (WMFT), Motricity Index (MI), Chedoke—McMaster Stroke Assessment (CMSA) and Stroke Rehabilitation Assessment of Movement (STREAM) (Diserens et al., 2007; Gladstone et al., 2002; Sullivan et al., 2011). Appendix 1 briefly depicts the items, time of administration and psychometric properties of the measures.

Concepts of minimal detectable change and minimal clinically important difference

The focus of the present study was to examine the ability of an outcome measure to precisely quantify the motor changes in post-stroke hemiparesis. Hence, it is pertinent to discuss the related statistical properties. The minimal detectable change (MDC) and minimal clinically important difference (MCID) are key concepts that facilitate the interpretation of treatment outcome in clinical and research practice (Chuang-Stein et al., 2011; Finch et al., 2002; Lin et al., 2011).

The MDC signifies the smallest change in an outcome measure and can be detected beyond the measurement error. It is an objective as well as a statistical attribute. The MCID is the smallest change in an outcome measure that would be considered important by the patient or clinician (Schmitt and Di Fabio, 2004). Patients who experience an estimated MCID score are more likely to experience a meaningful improvement in their disability level than those who do not experience such a score (Arya et al., 2011b) The MDC and MCID may provide some information about the minimal motor changes that are assessed by a measure. However, MDC and MCID of each measure in various contexts are sparsely available.

Brunnstrom recovery stage: a reference line for motor recovery assessment

In the majority of post-stroke hemiparetic patients, a stereotyped sequence of events takes place during motor recovery. Each higher stage indicates positive recovery. Based on longitudinal observation of many patients, Signe Brunnstrom defined the motor recovery stages. (Sawner and LaVigne, 1992). Six to seven recovery stages each for the upper limb and hand have been described. The stages are given in Box 1

Brunnstrom recovery stage (BRS) is the only stroke-specific and commonly used clinical method to classify the level of post-stroke motor recovery. BRS is a subjective method of classification, and it has also been used as an outcome measure in various studies. It is a reliable, valid and responsive measuring tool (Chang et al., 1990; Hashimoto et al., 2007; Huang et al., 2010; Hwang et al., 2005; Lee et al., 2012; Naghdi et al., 2010; Pandian et al., 2012; Safaz et al., 2009; Yavuzer et al., 2008). Brunnstrom Recovery Stage — arm (BRS-A) and Brunnstrom Recovery Stage — hand (BRS-H) were applied to record intrinsic recovery and prognosis of arm and hand in acute stroke. Recovery of the hand usually lags behind the rest of the limb (Chang et al., 1990).

A stroke-specific measure should evaluate neuromuscular progress, revealing motor control by the central nervous system. The measure should also be able to detect any motor recovery in relation to the stage. In the present study, the outcome measures were reviewed considering while BRS as a reference line for post-stroke hemiparetic motor recovery.

Fugl—Meyer Assessment

Fugl—Meyer Assessment (FMA) is the first stroke-specific assessment tool that was developed on the basis of Brunnstrom's motor recovery stages. It is a feasible, well-designed, responsive, and efficient tool (Fugl-Meyer et al., 1975; Gladstone et al., 2002). The FMA is based on the natural