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Stroke Scales and Trajectory of Recovery: A Major Concern for Patients and Nurses Alike

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Abstract

Introduction: Stroke recovery is a major issue of concern for the surviving patient and family but its rate varies from person to person. Existing prognostic models for stroke recovery are commonly based on stroke level of neurological deficit on admission.

Aim: The aim of this discussion paper was to review stroke progression and analyse the trajectory of stroke recovery. It also addressed the value of using standardized neurological assessment tools in routine stroke care and the integration of easy to use assessment tools into everyday nursing practice.

Methods: Medline and Google Scholar databases were searched using combinations of the following keywords: scale, stroke, rehabilitation and nursing from 2000 onwards.

Results: Popular scales used in stroke practice and research, including attempts to evaluate patient progress after stroke can be divided as follows: i) *Neurological deficit scales* ii) *Functional outcome* iii) *Global outcome scales* iv) *Health related quality-of-life scales.* The assessment tools for discussion in this paper are the Scandinavian Stroke Scale (SSS) the Barthel Index of daily living (BI) and the modified Rankin Scale (mRS). All three measures are well established in the international literature as reliable and valid of stroke outcomes and have been used in numerous large scale studies.

Due to the diversity of available outcome measures for acute stroke choosing one tool is challenging and using more than one scale implies that the scales are imperfect. Yet, consistent and routine use of validated and standardized tools for neurological and functional assessment of stroke survivors in conduction with well established treatments and management guidelines complement effective patient care.

Conclusions: This paper argues that despite barriers to routine use of stroke scales as reported by some nursing staff, particular efforts should be made in nurse training to introduce and demonstrate the importance of stroke scales. Their use not only provides a reliable record of progress but also contributes to optimum patient care and outcomes.

Keywords: Stroke; Scale; Rehabilitation; Nursing

Introduction

Stroke imposes substantial personal, financial and social burdens on individuals and families worldwide. Despite advances in diagnosis and treatments, it remains a major cause of death and long-term disability. Approximately one third of stroke patients

will die within the first 12 months, the majority of whom during the first week of onset, another third will be permanently disabled and dependent on the assistance of others while the remaining will return home with functional independence [1].

Stroke recovery is a major issue of concern for the surviving patient but its rate varies from person to person. Although some patients make a remarkable recovery, often this depends on the structure of services as effective rehabilitation interventions initiated early after stroke onset can enhance the recovery process and minimize functional disability. Steady and marked functional improvements bring enhance patient outlook and reduce potential costly long-term care expenditures.

Yashin et al. [2] introduced a working definition of stroke recovery by evaluating time trends in recovery rates and investigating incidence rates with regard to age and co morbidity using data from Medicare files linked with the USA National Long-Term Care Survey. The authors claim that although time trends in the recovery rate from stroke exist and can be detected, more studies are needed to evaluate changes in quality of life after stroke.

Weimar et al. [3] argue that stroke incidence and outcome in epidemiological studies vary widely within and across geographical locations. Ali et al. [4] examined differences in the Virtual International Stroke Trials Archive (3284 patients) for stroke severity and outcomes across geographical locations. They found that patients enrolled in the United States and Canada had the most severe index strokes. With regard to European populations, patients in Germany had the worst functional outcomes while patients in Austria and Switzerland had the best at 90 days. Greece, like other Mediterranean countries such as Spain, Portugal and Israel, had a significantly better survival rate from stroke when compared with those enrolled in the United States and Canada. The authors concluded that for patients enrolled in stroke clinical trials, regional variations in ischaemic stroke severity, outcome and mortality over the past 13 years could be only partially explained by case mix differences.

Aim

The aim of this discussion paper was to review stroke progression and analyse the trajectory of stroke recovery. Typical examples of scales used in stroke progress and overall assessment are also presented. This article addresses the value of using standardized neurological assessment tools in routine stroke care and the integration of easy to use assessment tools into everyday nursing practice.

Methods

Research materials for this paper's needs were located via the Medline and Google Scholar online databases. Relative searching included combinations of the following keywords: stroke, scale, rehabilitation from 2000 onwards.

Stroke trajectory of recovery

Predicting recovery rate after acute stroke is a major concern for patient and family and Health Care Professionals (HCPs) are often faced with enquiries with regard to an expected course of the condition and specific timeframes of recovery. Many studies have evaluated outcome after stroke, but quantification of patient recovery patterns are limited. One optimum model for prognosis of functional recovery after stroke as measured by the Barthel Index which includes neurological state (limb deficit, dysarthria, dysphasia) functional state (urinary incontinence) should also include patient's demographics (sex, age and pre-stroke disability), which affect rate of recovery and final outcome after stroke.

Although trajectory analysis for recovery from a serious condition is a quantitative way of describing changes on a time continuum where the influence of covariates is considered, the uncertainty of the stroke trajectory causes particular difficulties for HCPs in making an 'informed prognosis' and additional stress to the patient and family due to the lack of clear message regarding prognosis and final outcome. Qualitative trajectory schemes do not refer to the treatment plan exclusively but refer to personal accounts by stroke sufferers, the developmental stages of illness experienced in time and the meaning and effect of illness on the life and self-image of sufferers and their families [5].

Furthermore, a course of stroke trajectory based on the Corbin and Strauss chronic illness trajectory framework as an alternative to current stroke rehabilitation ethos and practices could be of important clinical use. This model has special implications for nursing practice as it challenges the curative and short aimed focus prevailing in the nursing clinical rehabilitation environment.

Four trajectory phases for stroke in the first year could be described as follows: the onset phase (1-7 days) is one of surprise and suspense and includes early rehabilitation steps; the second phase (1-8 weeks) involves the hard physical work of rehabilitation to regain body functions; the third phase (8 weeks to 6 months or more) involves continued rehabilitation which focuses on psychosocial, practical adjustments 'reinterpreting' the impact of stroke and finally the semi-stable phase (6 months to one year or more) getting on with life, adjusting to long term effects including minimising the effects of stroke on one's life and self. The first acute phase is in hospital, the second in hospital rehabilitation or other rehabilitation environment, the third is at home with outpatient visits and the fourth phase also continues at home. Hence an early and reliable prognosis for recovery in stroke patients is important for the initiation of individual treatment essential for hospital staff, and for informing patients and relatives.

Data collected from tracking the experiences of six stroke patients demonstrates that recovery from stroke involves restructuring and adaptation in physical, social and emotional aspects of an individual's life. Although there is no common path of recovery he recommends that stroke services should be structured to take account of the trajectory needs of stroke patients and their families in their homes. A later study by Burton and Gibbon [6] stresses that home visits from a stroke nurse after hospital discharge focusing on education and support, has tangible benefits for patients by reducing deterioration and improving physical independence from 3-6 months and also reducing the strain on carers.

However, this is an aspect of care which is often overlooked in countries with poor social or community nursing services. In the Balkans for example, there are no services for follow-up assistance in the home due to decades of financial austerity to various branches of nursing and inadequate concern about the health of stroke patients once outside the hospital setting. Such services are even more unlikely to be introduced in Greece in particular, the current economic circumstances - unless a philanthropic source might show interest [7].

According to the National Centre for Health Statistics in the US, the average length of hospitalisation for stroke decreased by 7.3 days between 1988 and 2005 that is from 12.3 to 5.0 days. Latest statistics for the US show that the average length of stay for stroke patients is 5.3 days [8]. Shaughnessy et al., [9] argued that individual trajectories after stroke indicate that recovery was highly variable. After examining neurological and cognitive status, depression and functional ability alongside demographic data (age, gender, marital status, laterality of lesion), she concluded that there is a significant association between the outcomes and post-stroke depression negatively affecting patient progress. The author also emphasised the importance of identifying the influences that optimise functional recovery following stroke and that this should continue to be a priority for stroke research including both the acute phase and rehabilitation. The use of qualitative methodologies was also proposed as a means of providing stroke researchers with a better understanding of this process.

However, Kasner [10] observes that there is not a single scale which, on its own, can predict all aspects of recovery, including disability, after acute stroke. Hence the continued recommendation to combine scales to include the NIHSS or similar deficit scale (such as the SSS), the BI and the mRS.

Stroke scales in clinical practice

The course of stroke recovery starting from onset to final outcomes that are ranging from full independence and symptom-free stage to death require robust measures of functional recovery, neurological state and general life assessments. Although there are several instruments in use, all have recognised limitations. Some examples include the following:

i) *Neurological deficit scales* such as: Scandinavian Stroke Scale (SSS),

ii) *Functional outcome* scales such as: Barthel Index of Daily Living (BI),

iii) *Global outcome scales* such as: Modified Rankin Scale (mRS),

The above selected stroke tools for discussion in this paper are well established in the international literature as reliable and valid of stroke outcomes and have been used in numerous large scale studies such as: Alteplase Thrombolysis for Acute Non-interventional Therapy in Ischaemic Stroke-ATLANTIS, [11] Abciximab in Emergency Treatment of Stroke Trial-AbESTT [12], and International Stroke Trial-3 [13]. A brief description of each measurement together with basic information on scoring, validity and reliability is as follows:

The scandinavian stroke scale

The Scandinavian Stroke Scale assesses the functionality of nine neurological states using a scale of 0-6, where 0 represents severe malfunction and 6 represents full functionality. The scale's minimum score is '0' and the maximum '58'. The nine items include: Consciousness, Eye movement, Arm/hand/leg motor power (each assessed only on the affected side), Orientation, Speech, Facial palsy and Gait). Total scores can be used to stratify patients into four categories of stroke severity (**Table 1**) as described by Ellul et al. [14].

The SSS has been widely used in clinical research to summarise the neurological deficits in stroke patients. It is useful in documenting and communicating baseline deficits, as well as changes over time and it consists of a prognostic score and a long-term score, with the latter excluding consciousness and eye deviation [15]. The validity and reliability of the SSS was tested by Barber et al., [16] who evaluated its components when applied in a retrospective manner. The item of 'aphasia' was tested in comparison to formal testing in an independent study by a speech therapist. The SSS has been translated in many languages, recently in Brazilian by Luvizutto et al. [17] who found it to be valid for studying patients with stroke.

The clinimetric performance of the SSS is similar to other acute scales such as the National Institute for Health Stroke Scale and the Canadian Neurological Scale. A low score on the SSS is a predictor of early neurological deterioration following acute ischaemic stroke and at baseline or 24 hours is a strong predictor of death within 30 days of a hemispheric ischaemic stroke. The SSS has been also shown to predict outcome in mild stroke [18,19].

When compared with five stroke scales the SSS was found to have high concurrent validity with measures of disability, handicap, and quality of life. Sandset et al. [20] have recently used the SSS to investigate the angiotensin-receptor blocker candesartan for acute stroke treatment. This randomised, placebo-controlled, double-blind trial showed no indication that careful blood-pressure lowering treatment with this receptor blocker was beneficial in patients with acute stroke and raised blood pressure. The authors state that, if anything, the evidence suggests a harmful effect. It is of interest that the SSS tool was of value in contributing to this decision.

Barthel index

The Barthel index (BI) was originally developed in 1965 by Mahoney and Barthel to evaluate functional performance in activities of daily living in stroke patients before and after treatment and also reflected the amount of nursing care

Table 1 SSS categories.

SSS scores	*Category*
0–18	*Very severe stroke*
19–32	*Severe stroke*
33–44	*Moderate stroke*
45–58	*Mild stroke*

needed for these patients [21]. Although the BI has been extensively used in intervention studies and observational studies such as this one, it has also been used as a measure of functional outcome in rehabilitation settings.

The BI is an ordinal scale (rather than an interval level scale) that measures disability and functional independence. The BI is a measure of dependence in activities of daily living, ranging from 0 (totally dependent) to 100 (totally independent), generating ordered categorical data.

The original 10-item BI covers the following domains of personal care and mobility: feeding, bathing, grooming, dressing, incontinence bowel/bladder, toilet use, transfers (bed to chair and back), mobility and stairs. For two items (bathing, grooming) scores range from 0 (dependence) to 5 (independence). A further six items (feeding, dressing, incontinence bowel/bladder toilet, stairs) range from 0-10. Finally, two more items (transfers and mobility) range from 0-15. The BI scores have been categorised **(Table 2)** as follows [22,23].

The BI comes in various forms, ranging from a 3-item short version to an expanded 18-item one, although the 10-item version is the most commonly used. Currently, no permission is needed to use the BI in all versions.

The BI omits certain sophisticated tasks of daily living such as cooking and shopping which are more appropriate for community settings. The BI was originally designed to evaluate functional performance in long term hospitalised patients with paralytic and other debilitating conditions (such as stroke) before and after treatment. It has been widely used for institution populations for whom it was originally designed.

Overall, the BI has been reported to have good reliability with an average inter-rater correlation of 0.99. Intra-observer and inter-observer reliabilities are also quite high, with Pearson r scores ranging from 0.89 to 0.99. Alpha internal consistency reliability coefficients of 0.87 to 0.92 for the original scoring system on admission and discharge. Furthermore, the BI has been demonstrated to have internal consistency of 0.96 with neurological out-patients with stroke. Many investigators continue to justify the use of the original BI, especially for studies of stroke.

The validity of the BI has also been reported to be high with validity correlations between 0.73 and 0.77 in motor ability for 976 stroke patients. With regards to construct validity, the BI correlated well with clinical judgment and was shown to predict mortality and ability to be discharged to a less restrictive environment.

Modified rankin scale

The Rankin Scale (RS) was developed in 1957 to assess the extent of disability after a serious illness such as stroke and the functional status of patients. The scale does not follow the typical pattern of incremental numbers that is patients with no impairment or symptoms receive the best score of 0, while patients with severe disability who are bedridden, incontinent, and require constant nursing care and attention receive the worst score of 5. The original scale was 0-5, later modified (mRS) to a 7-point scale [24]. The mRS scores from 0 to 2 are classified as independent; patients scoring 3 to 5 are categorised as experiencing moderate to severe disability. On the mRS, death is rated 6.

The mRS has moderate to excellent inter-rater reliability [25,26]. As it is a broad-based resume of impairment and inactivity, it lacks specificity in domains such as cognition verbal communication or pain which are not directly measured. It has only one question with a six point scale, so its simplicity is indisputable. However, rating scales with more items or rankings generally offer higher reliability.

Furthermore, the mRS has good validity ratings and is considered by many authors to be more powerful than the Barthel Index (BI) as a primary endpoint in clinical trials of stroke therapy [27,28]. The mRS has moderate concurrent validity which is similar to findings for the BI and other scales. Its construct validity has also been shown to agree with other rating scales [29]. An overview of the three scales' reliability and validity performance is shown in **Tables 3** and **4**.

Discussion

Stroke has been described as a dramatic event that leaves both patient and carers astonished. A primary concern immediately after stroke for patients, their relatives, and caregivers is the prospect for full recovery. Often clinicians are faced with hard questions with regard to the quantity, quality and timeline of progress. Although many attempts have been made to create average recovery prognostic models, early recovery after stroke depends heavily both on systemic and local implications.

With regard to systemic factors, the importance of better management of hyperglycaemia, temperature and swallowing in acute stroke patients during the initial 72 hours of admission is stressed. Their trial clearly shows the effect of good nursing care on clinical outcomes. Local complications include the course of pathophysiological patterns of recovery in the brain tissue, such as the early resolution of oedema which surrounds the infracted area; also early resolution of diaschisis, that is early restoration of depressed total brain function as a result of a sudden interruption

Table 2 BI score categories.

BI score	*Category*
BI<30	in need of 'institutional care'
30 -70	help needed
BI≥70	functional independence

Table 3 Cronbach's α **.**

Total SSS	*0.87*
Total BI	*0.94*

Table 4 Correlations between the total scores of the three scales (SSS, BI, mRS) .

Total SSS	Total BI	Total mRS
	Spearman's *rho* = 0.787 *p*<0.001	Spearman's *rho* = -0.520 *p*<0.001
Total BI		Spearman's *rho* = -0.520 *p*<0.001

of major neurotransmittion input to a part of the brain remote from the site of the initial infarct area [30]. Although there is no set timeline for recovery after stroke, HCPs should be able to give patients some idea of the prognosis time scale and what limitations to expect.

Although stroke severity can fluctuate during the first week, assessments at day one and day seven post stroke provide day ninety post stroke and subsequent long term disability estimates [31].

In the Copenhagen Stroke Study which was a prospective community based study that evaluated the outcome of stroke according to both initial stroke severity and initial level of disability, the Scandinavian stroke Scale and Barthel Index were used respectively. The study showed that 78% of stroke survivors had no or only mild deficits on discharge and that even the most severe cases regularly experience meaningful improvement during rehabilitation [32].

Although stroke is the most common life threatening neurological disorder globally, attempts to describe individual trajectories of recovery following stroke, and identify variables associated with functional decline and recovery over twelve months are limited. Identifying influences that optimise functional recovery following stroke should continue to be a priority for researchers and clinicians alike.

Due to the varied nature of acute stroke symptomatology, often erratic recovery rates including progress results, the use of scales for prognostic purposes have been openly criticised. The BI has been accused of having both a 'ceiling' and a 'floor' effect, wherein the maximum score can be achieved by patients whilst still disabled and the minimum by those who are bedbound due to routine hospital practice rather than actual stroke severity [33].

However, in Europe, the SSS is equally if not more popular in stroke research since it was first devised by the Scandinavian Stroke Study Group (1985) three decades ago. Both the BI and the SSS have been chosen by many authors to estimate functional status and have also been used as the main tools for recovery prediction in various trajectory models after stroke. A BI scoring of 0-100 with 5-point increments has also been suggested to become a uniform tool for functional status assessment after stroke. The SSS has been also used in many clinical trials to assess neurological states, immediate and long term survival, with stroke severity based on mean or median SSS ± SD scores [34].

Severity of stroke has been described as a well-established predictor of outcome and stroke severity as estimated with the SSS is significantly associated especially with short-term rather than long-term survival. It has also been found that baseline BI is a good long term predictor of 5-year survival after stroke.

Using the SSS and BI weekly, Jørgensen et al. [35] reported that the time course of recovery could be predicted. Of their sample, 95% had completed functional recovery by 12.5 weeks from stroke onset although this duration was strongly influenced by initial stroke severity. The recovery time for activities of daily living (BI) was reached earlier, by 8.5 weeks (mild stroke); within 13 weeks (moderate stroke) and 17 weeks (very severe stroke). Yet 80% of all patients in their study took only six weeks reach their best ADL functionality. On parallel, neurological recovery followed a time course pattern similar to functional recovery, although for these patients neurological recovery was reached by four weeks.

Due to the diversity of available outcome measures for acute stroke choosing one tool is challenging and using more than one scale implies that the scales are imperfect and the mRS has been suggested as a preferred outcome measure for acute trials [36].

Richardson et al. [37] argued that consistent and routine use of validated and standardized tools for neurological and functional assessment of stroke survivors in conduction with well established treatments and management guidelines complement effective patient care. Thus, routine use of stroke scales can improve medical documentation and internal communication between health care professionals. Furthermore, the use of standardised measurements for initial neurological assessment and timely monitoring of neurological status provide a measure by which to analyse quality of care [38].

Conclusions

There is strong evidence that organized, interdisciplinary stroke care will not only reduce mortality rates and the likelihood of institutional care and long-term disability but also may enhance recovery and increase ADL independence. Thus, universal stroke assessment tools are important in clinical practice as they provide staff, patients and carers an objective insight in progress and potential outcomes.

Generally in clinical trials and routine stroke care in particular, selection of a specific primary endpoint is critical to detecting, assessing, measuring and comparing differences between groups or interventions. The ideal clinical stroke scale should have the following features; be simple, easy to use, quick to administer, hold a high reproducibility by one observer and between observers, and give useful prognostic information.

Today, stroke scales are even more essential for research and clinical audits in order to evaluate stroke severity, compare outcomes and assess residual disability in ways that are both meaningful to clinicians and of pragmatic, real life value for patients. Unfortunately, to-date there is no single globally agreed validated stroke assessment scale in routine clinical and research use. Nevertheless, the three scales outlined in this paper hold a great potential for use by nursing staff.

This present paper argues that despite barriers to routine use of stroke scales as reported by some nursing staff, particular efforts should be made in nurse training to introduce and demonstrate the importance of stroke scales. Their use not only provides a reliable record of progress but also contributes to optimum patient care and outcomes.

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