Recovery After Stroke: Comparison of Four European Rehabilitation Centers

(study background and data description)

Introduction/Motivation

Stroke (*mozková mrtvice*) is a major health burden throughout Europe, consuming significant resources. Multidisciplinary rehabilitation in inpatient stroke rehabilitation units results in lower mortality, less disability, and less need for institutionalization compared with care on general wards. Previous studies have shown that outcome after inpatient stroke rehabilitation differs widely across Europe. This study was designed to compare motor and functional recovery measures after stroke between four European rehabilitation centers.

The study was conducted in four European rehabilitation centers: Pellenberg, *Belgium*; Nottingham, *the United Kingdom*; Zurzach, *Switzerland*; Herzogenaurach, *Germany*. Each center had a stroke rehabilitation unit with the provision of inpatient multidisciplinary care. Patients were transferred to these units from an acute setting. Between March 2002 and September 2004, all consecutive patients fitting the following inclusion criteria were recruited: (1) first-ever stroke as defined by WHO; (2) score on Rivermead Motor Assessment (Lincoln and Leadbitter, 1979) of Gross Function (RMA-GF) 11, and/or score on Rivermead Motor Assessment of Leg/Trunk (RMA-LT) function 8 and/or score on Rivermead Motor Assessment of Arm (RMA-A) function 12 on admission to the center; and (3) age 40 to 85 years. The upper age limit was to avoid inclusion of patients with a high number of comorbidities. The exclusion criteria were: (1) other neurological impairments with permanent damage; (2) stroke-like symptoms caused by subdural hematoma, tumor, encephalitis, or trauma, (3) admission to the center >6 weeks after stroke (to exclude chronic stroke patients); (4) no informed consent; and (5) prestroke Barthel Index (BI, Mahoney and Barthel, 1965) <50 (to be able to distinguish between pre-existing disabilities and disabilities resulting from the stroke). In total, 532 patients were recruited to the study (127 patients in Belgium and 135 patients in each of the three remaining countries).

Motor and functional recovery were assessed on admission to the center and at 2, 4, and 6 months after stroke with the RMA-GF and BI, respectively. Additionally, the Nottingham Extended Activities of Daily Living (NEADL, Nouri and Lincoln, 1978) was assessed 2, 4, and 6 months after stroke to evaluate independence in instrumental activities of daily living. The end point was 6 months after stroke as most motor and functional recovery takes place before that time. To enable adjustment for initial conditions, several variables were documented based on previous studies of prognostic factors for motor and functional recovery: age, gender, time between stroke onset and admission assessment, prestroke disability (assessed by BI), type of stroke, side of impairment, urinary incontinence, and swallowing problems were recorded on admission. The occurrence of dysarthria and dysphasia were documented using items of the National Institute of Health Stroke scale (Brott et al., 1989). At discharge, length of stay was recorded.

Data files

All together, there are two (`xls`) data files available separately for the follow-up of RMA-GF and NEADL scores. Additionally, there is an R script file containing data on Barthel index. The files can be downloaded from the official course website in SIS (student's login required).

In the Excel files, there is one line per patient and the following variables:

`center` numeric value (1, 2, 3, 4) identifying the center;

`patcode` character identifying uniquely each patient;

`LOS` length of stay in the centre (number of days between intake to and discharge from the centre);

`TSOIntass` time between stroke onset and intake assessment (days);

`TSODisass` time between stroke onset and discharge assessment (days);

`TSO2Mass` time between stroke onset and 2-months assessment (days);

`TSO4Mass` time between stroke onset and 4-months assessment (days);

`TSO6Mass` time between stroke onset and 6-months assessment (days);

`currresintass` residence at time of intake assessment (1 = rehabil. centre, 0 = other);

`currresDisass` residence at time of discharge assessment (1 = rehabil. centre, 0 = other);

`curres2Mass` residence at time of 2-months assessment (1 = rehabil. centre, 0 = other);

`curres4Mass` residence at time of 4-months assessment (1 = rehabil. centre, 0 = other);

`curres6Mass` residence at time of 6-months assessment (1 = rehabil. centre, 0 = other);

`Gender` gender (1 = female, 0 = male);

`age` age at stroke onset;

`Bleeding` presence of bleeding (1 = yes, 0 = no);

`comorbidity` number of comorbidities (0 – 7);

`UI` urinaire incontinentie (1 = incontinent, 0 = continent);

`Swallow` swallow problems (*polykací potíže*, 1 = yes, 0 = no);

`dysphasia` presence of dysphasia (*poruchy řeči*, 1 = yes, 0 = no);

`dysarthria` presence of dysarthria (*poruchy artikulace*, 1 = yes, 0 = no);

`RMAint` RMA-GF score at intake assessment (0 – 13);

`RMADis` RMA-GF score at discharge assessment (0 – 13);

`RMA2M` RMA-GF score at 2-months assessment (0 – 13);

`RMA4M` RMA-GF score at 4-months assessment (0 – 13);

`RMA6M` RMA-GF score at 6-months assessment (0 – 13);

`EADL2M` NEADL score at 2-months assessment (0 – 22);

`EADL4M` NEADL score at 2-months assessment (0 – 22);

`EADL6M` NEADL score at 2-months assessment (0 – 22).

Note that not all patients have data on all five occasions (intake, discharge, 2, 4, 6 months) due to some drop out during the study. Missingness is indicated by empty cells in TSO, `curres`, `RMA` and `EADL` variables. It is claimed that the missingness patterns in those variables should be the same for each patient[1]

Data on Barthel index measurements are available upon running the R script. It creates three vectors: `age`, `BI` (0, 1, 2, 3, 4) and `center`. In contrast to the Excel files, data provided here are in a "longitudinal format", i.e., several (up to five) consecutive values per patient that correspond to (i) intake, (ii) discharge,

[1] Důvěřuj, ale prověřuj!

(iii) 2-months, (iv) 4-months, (v) 6-months measurements. Missing values have already been removed from data. The `age` vector just repeats for each patient his/her/its age at stroke onset. Within each centrum, patients in this datafile are sorted in the order as in the RMA-GF and NEADL datafiles. Nevertheless, the order of centra is different! Use the `age` variable to check whether the BI data are correctly merged with the RMA-GF and NEADL data.

Outcome variables

Both *Rivermead Motor Assessment of Gross Function* (RMA-GF) as well as *Nottingham Extended Activities of Daily Living* score (NEADL) are ordinal variables with 0 meaning the worst performance. For descriptive part of the analyzis methods for both numeric as well as categorical data might be useful. Nevertheless, for the main analysis, the chosen methods should definitely take into account the following facts (among the other things): (i) the support of both scores is bounded, (ii) the probability mass of the respective distribution might be considerably concentrated also around boundaries (perhaps on both sides), (iii) the mean (as well as any other location parameter) is perhaps not really appealing characteristic of the respective distribution.

The *Barthel index* is originally a score on an interval $[0, 100]$ (with values being multiples of 5, see, e.g. this link), where zero means that the person depends completely on others in daily activities whereas 100 means full independence on others. In delivered dataset, the Barthel index is already categorized in five classes (labeled 0, 1, 2, 3, 4) corresponding to original values 0 – 20, 25 – 40, 45 – 60, 65 – 80, 85 – 100.

Primary aim of the analyzis

Despite the evidence that organized care in stroke rehabilitation units is associated with improved outcome, there is a limited knowledge of the components of such care that are responsible for this benefit. Comparing inpatient stroke care and recovery patterns across different European countries might improve our understanding of stroke rehabilitation and may help develop optimal models for delivery of stroke care. Hence the main purpose of the analyzis is to compare the four centra with respect to evolution of either of the outcomes related to motor and functional recovery after stroke. Due to possible heterogeneity in patient characteristics in different countries, the analyzis must definitely take into account this heterogeneity. Conclusions should also provide some recommendations on which type of care (which center) is the best/worst while mentioning limitations of such conclusions.

References

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