

Stroke outcomes in Croatian patients measured by modified Rankin scale

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ABSTRACT - The objective of this study was to measure functional outcomes in stroke patients undergoing rehabilitation at a Croatian rehabilitation center using modified Rankin scale (mRS). Data on 90 stroke patients treated in 2010 and 2011 were analyzed according to gender, age at stroke, days from stroke to the initiation of rehabilitation, type, side and severity of stroke, length of stay, comorbidity and program of rehabilitation. Initial and final mRS scores and change (progress) in the patients' functional abilities were recorded and compared. Patients presented with mRS scores at rehabilitation initiation (4.07 ± 1.00) indicative of high dependence, and it was higher in patients aged >65 (4.21 ± 0.97), hemiplegic patients (4.94 ± 0.25) and those with two or more comorbidities (4.27 ± 0.79). The length of stay was longer than 21 days in patients with higher initial mRS scores (4.61 ± 0.64). The mRS score at the end of rehabilitation was 3.10 ± 1.18 , with significant functional improvement of 0.97 ± 0.66 in mRS score. All subgroups of patients improved in mRS score, too. The length of stay of hemiplegic patients (44 ± 11 days) was appropriately longer than in hemiparetic patients (29 ± 12 days) ($p < 0.001$) achieving similar mRS improvement as in hemiparetic patients ($p = 0.06$), although slightly more in favor of hemiparetic patients (1.03 ± 0.66 vs. 0.69 ± 0.60). In conclusion, rehabilitation efforts were indicated on time and to the extent of the individual rehabilitation needs, and were useful in all patients regardless of age, comorbidity, type and severity of stroke.

Key words: outcome, modified Rankin scale, stroke

INTRODUCTION

Functional outcome in stroke patients depends of the treatment provided by an interdisciplinary team of experienced professionals (1,2). The aim of rehabilitation is not only to teach patients to take care of themselves, but to integrate them back into society. In that crucial part of their lives, rehabilita-

tion plays a major role (3). The modified Rankin scale (mRS) is a clinician-reported measure of global disability and has been widely applied for evaluating stroke patient outcomes (4-6). This scale measures independence rather than performance

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of specific tasks (Appendix 1). It consists of six grades from 0 to 5 and additional category '6', which means death. According to them, score ≤ 2 corresponds to independence. Limitations in the use of mRS include lack of consensus on the impact of change in mRS rating to the actual performance of the patient (7-9), or patient's comorbidities (diabetes or cardiovascular diseases) (10) that can influence physical functioning and cognitive abilities. The aim of the study was to assess initial and final mRS scores and improvement in patients' status during inpatient rehabilitation, and to evaluate differences in improvement according to time from stroke to rehabilitation initiation, length of stay, side involved, type of stroke (ischemic or hemorrhagic), severity of stroke (plegia or paresis), gender, age, comorbidity (none or only one *versus* more than one comorbidity) and program of rehabilitation (full or partial).

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MODIFIED RANKIN SCALE (MRS)

Patient Name: _____

Rater Name: _____

Date: _____

Score	Description
0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead
Total (0-6): _____	

Appendix 1

PATIENTS AND METHODS

Data on 90 stroke patients were analyzed. Data were collected at a tertiary care unit in a specialized rehabilitation hospital, in accordance with ethical standards of the institution. We recorded data on gender, age at stroke, time from stroke to the initiation of rehabilitation, length of stay at rehabilitation, severity of stroke (plegia or paresis), side of stroke (left or right), type of stroke (ischemic or hemorrhagic), mRS scores at the initiation and at the end of inpatient rehabilitation, difference (change) in mRS scores, type of program (full, including hydrokinesitherapy, or partial, without hydrokinesitherapy but comprising of kinesitherapy, occupational therapy, speech therapy, massage and various forms of electrotherapy, if indicated) and comorbidity (hypertension, diabetes, hyperlipidemia, atrial fibrillation, etc.). Paired t-test for equality of means was used to determine if differences existed before-after study, while independent t-test was used to determine if difference existed between groups of patients. For all analyses, the level of significance was set at $p < 0.05$. Descriptive statistics was used and data were presented as mean \pm standard deviation (SD). Distribution was tested with Kolmogorov-Smirnov test. Statistical analysis was performed using the SPSS for Windows, version 13.0.

RESULTS

The study included 90 stroke patients undergoing inpatient rehabilitation in 2010 and 2011 (Table 1), 41 male and 49 female patients, 46 with left-side and 44 with right-side involvement.

The mean age at stroke was 69 ± 11 (median=71, range=31-85) years, with 29 (32%) patients aged ≤ 65 and 61 (68%) patients aged > 65 . Patients presented to rehabilitation ward at 31 ± 25 (median 23, range 7-164) days following stroke; 59 (66%) at ≤ 30 days and 31 (34%) at > 30 days following stroke. The overall length of stay at rehabilitation ward was 31 ± 13 (median=28, range=17-81) days, with 39 (43%) patients staying at the ward for ≤ 21 days and 51 (57%) patients for > 21 days. Sixteen (18%) patients presented with paralysis and 74 (82%) with paresis of the affected side. Seventy (78%) patients suffered from ischemic stroke and 20 (22%) from hemorrhagic incidents. Full rehabilitation program modalities including hydrokinesitherapy were used in 77 (86%) patients, while comorbidities and overall poor health prevented 13 (14%) patients to be fully involved. Comorbidity was present in 85

Table 1. General data (number and percentage of patients within subgroups)

General data	Subgroup	n	%	Subgroup	n	%
Gender	Male	41	46	Female	49	54
Age (yrs)	≤65	29	32	>65	61	68
Days of stroke	≤30	59	66	>30	31	34
Length of stay (days)	≤21	39	43	>21	51	57
Severity	Hemiplegia	16	18	Hemiparesis	74	82
Side	Left	46	51	Right	44	49
Type	Ischemic	70	78	Hemorrhagic	20	22
Program	Full	77	86	Partial	13	14
Comorbidity	0-1	35	39	2 or more	55	61

Table 2. Comorbidities in patients with stroke (number and percentage of patients with comorbidities)

Hypertension	76	84
Diabetes	25	28
Hyperlipidemia	25	28
Atrial fibrillation	21	23
Alcohol abuse	4	4

(94%) patients; 35 (39%) patients were without any or with one comorbidity, while 55 (61%) patients had two or more comorbidities (Table 1). The most frequent comorbid condition (or risk factor) was hypertension in 76 (84%) patients, followed by diabetes and hyperlipidemia in 25 (28%) patients and atrial fibrillation in 21 (23%) patients (Table 2).

Initial mRS score at rehabilitation initiation

The mean mRS score at rehabilitation initiation in all patients was 4.07 ± 1.00 (median=4, range=1-5) and by subgroups it is presented in Table 3.

It was higher in patients aged >65 (4.21 ± 0.97) than in younger patients (3.76 ± 1.02 ; $p=0.04$) (Fig. 1), in hemiplegic patients (4.94 ± 0.25) than in hemiparetic patients (3.88 ± 1.01 ; $p<0.001$) (Fig. 2), and in patients with two or more comorbidities (4.27 ± 0.79) than in those with none or one comorbid condition (3.71 ± 1.15 ; $p=0.007$) (Fig. 3).

As expected, the length of stay was longer than 21 days in patients with higher initial mRS scores (4.61 ± 0.64), and 21 days or less in patients with lower initial mRS scores (3.36 ± 0.96 ; $p<0.001$) (Fig. 4).

There were no differences in initial mRS scores between genders ($p=0.43$) or between patients with

Table 3. Initial mRS score at initiation of rehabilitation (mean ± standard deviation)

Initial mRS score	Subgroup	Initial mRS score (mean±SD)	Subgroup	Initial mRS score (mean±SD)	p
Gender	Male	3.98 ± 1.01	Female	4.14 ± 1.00	0.43
Age (yrs)	≤65	3.76 ± 1.02	>65	4.21 ± 0.97	0.04
Days of stroke	≤30	4.20 ± 0.91	>30	3.81 ± 1.14	0.07
Length of stay (days)	≤21	3.36 ± 0.96	>21	4.61 ± 0.64	<0.001
Severity	Hemiplegia	4.94 ± 0.25	Hemiparesis	3.88 ± 1.01	<0.001
Side	Left	3.87 ± 1.11	Right	4.27 ± 0.85	0.06
Type	Ischemic	4.11 ± 0.96	Hemorrhagic	3.90 ± 1.17	0.40
Comorbidity	0-1	3.71 ± 1.15	2 or more	4.27 ± 0.79	0.007

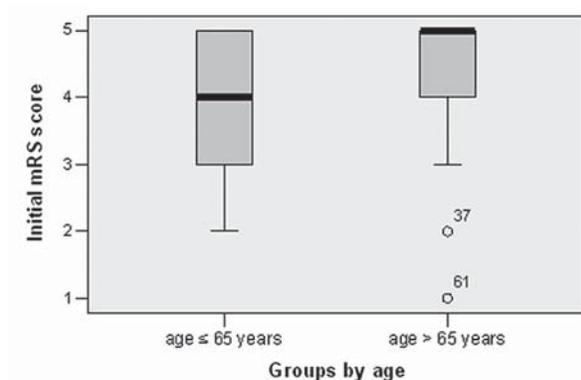


Fig. 1. Initial mRS score in patients aged ≤ 65 and > 65 years.

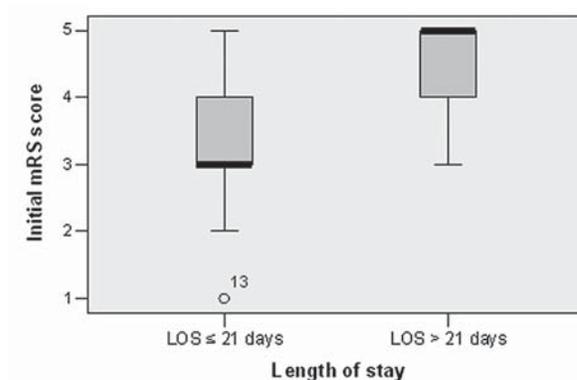


Fig. 4. Initial mRS score in patients with the length of stay of up to 21 days and more than 21 days.

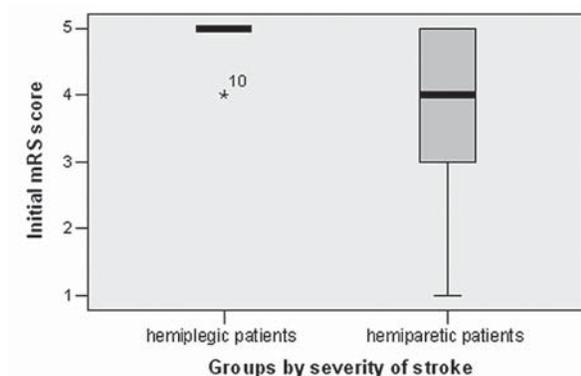


Fig. 2. Initial mRS score according to the severity of stroke: hemiplegia and hemiparesis.

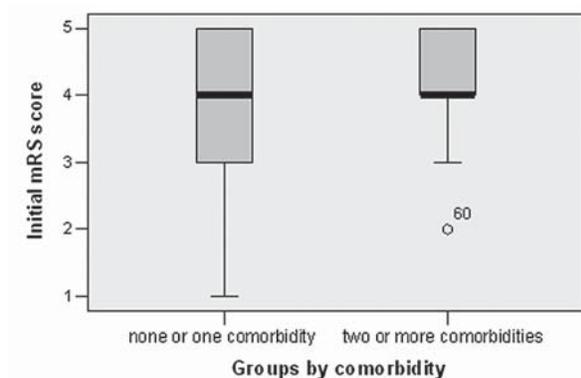


Fig. 3. Initial mRS score in patients with none or one, and with two or more comorbidities.

Improvement in mRS score

The mRS score at rehabilitation initiation was 4.07 ± 1.00 (median=4, range=1-5), and at the end of rehabilitation it was 3.10 ± 1.18 (median=3, range=1-5) (Fig. 5).

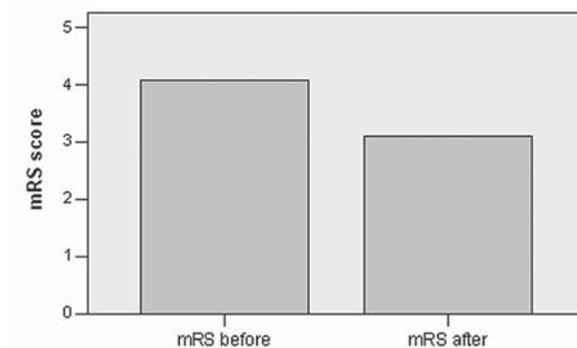


Fig. 5. mRS score of all patients at rehabilitation initiation (before) and completion of inpatient rehabilitation (after).

There were significant improvements in mRS scores between initiation and end of rehabilitation ($p < 0.001$), with a mean score of 0.97 ± 0.66 . All patient subgroups (by gender, age, days from stroke, length of stay, severity of dysfunction, side involved, type of stroke, type of program, and comorbidity) showed significant improvement in mRS scores (Table 4).

Differences in mRS progress between subgroups of patients are shown in Table 5.

There was no difference in mRS score improvement between patients arriving to rehabilitation before or after post-stroke day 30 ($p = 0.32$) or between patients with the length of stay up to 21 days

left-side and right-side affection ($p = 0.06$), although being slightly in favor of left-side affection (3.87 ± 1.11) compared to right-side affection (4.27 ± 0.85), or between ischemic or hemorrhagic etiology of stroke ($p = 0.40$). Initial mRS scores were similar in patients admitted to rehabilitation before or after post-stroke day 30 ($p = 0.07$).

Table 4. Initial mRS score, final mRS score and progress in mRS score on inpatient rehabilitation (mean \pm standard deviation)

mRS score before-after study		Initial mRS score (mean \pm SD)	Final mRS score (mean \pm SD)	mRS score progress (mean \pm SD)	p
All		4.07 \pm 1.00	3.10 \pm 1.18	0.97 \pm 0.66	<0.001
Gender	Male	3.98 \pm 1.01	2.93 \pm 1.13	1.05 \pm 0.59	<0.001
	Female	4.14 \pm 1.00	3.24 \pm 1.21	0.90 \pm 0.71	<0.001
Age (yrs)	\leq 65	3.76 \pm 1.02	2.86 \pm 1.25	0.90 \pm 0.62	<0.001
	>65	4.21 \pm 0.97	3.21 \pm 1.14	1.00 \pm 0.68	<0.001
Days from stroke	\leq 30	4.20 \pm 0.91	3.19 \pm 1.17	1.02 \pm 0.71	<0.001
	>30	3.81 \pm 1.14	2.94 \pm 1.21	0.87 \pm 0.56	<0.001
Length of stay (days)	\leq 21	3.36 \pm 0.96	2.26 \pm 0.97	1.10 \pm 0.64	<0.001
	>21	4.61 \pm 0.64	3.75 \pm 0.89	0.86 \pm 0.66	<0.001
Severity	Hemiplegia	4.94 \pm 0.25	4.25 \pm 0.58	0.69 \pm 0.60	<0.001
	Hemiparesis	3.88 \pm 1.00	2.85 \pm 1.13	1.03 \pm 0.66	<0.001
Side	Left	3.87 \pm 1.11	2.96 \pm 1.33	0.91 \pm 0.69	<0.001
	Right	4.27 \pm 0.85	3.25 \pm 0.99	1.02 \pm 0.63	<0.001
Type	Ischemic	4.11 \pm 0.96	3.16 \pm 1.14	0.96 \pm 0.71	<0.001
	Hemorrhagic	3.90 \pm 1.17	2.90 \pm 1.33	1.00 \pm 0.46	<0.001
Program	Full	4.06 \pm 1.02	3.09 \pm 1.21	0.97 \pm 0.69	<0.001
	partial	4.08 \pm 0.95	3.15 \pm 1.07	0.92 \pm 0.64	<0.001
Comorbidity	0-1	3.71 \pm 1.15	2.74 \pm 1.27	0.97 \pm 0.66	<0.001
	2 and more	4.27 \pm 0.79	3.35 \pm 1.08	0.92 \pm 0.68	<0.001

Table 5. Differences in mRS score progress between subgroups of patients (mean \pm standard deviation)

mRS score progress	Subgroup	mRS score progress (mean \pm SD)	Subgroup	mRS score progress (mean \pm SD)	p
Gender	Male	1.05 \pm 0.59	Female	0.90 \pm 0.71	0.28
Age (yrs)	\leq 65	0.90 \pm 0.62	>65	1.00 \pm 0.68	0.49
Days of stroke	\leq 30	1.02 \pm 0.71	>30	0.87 \pm 0.56	0.32
Length of stay (days)	\leq 21	1.10 \pm 0.64	>21	0.86 \pm 0.67	0.09
Severity	Hemiplegia	0.69 \pm 0.60	Hemiparesis	1.03 \pm 0.66	0.06
Side	Left	0.91 \pm 0.69	Right	1.02 \pm 0.63	0.44
Type	Ischemic	0.96 \pm 0.71	Hemorrhagic	1.00 \pm 0.46	0.80
Program	Full	0.97 \pm 0.67	Partial	0.92 \pm 0.64	0.80
Comorbidity	0-1	0.97 \pm 0.66	2 and more	0.96 \pm 0.67	0.96

or longer (p=0.09). Similarly, there were no differences according to the right and left side involvement (p=0.44), ischemic and hemorrhagic stroke (p=0.80), gender (p=0.28), age at the time of stroke

\leq 65 and \geq 65 (p=0.49), none or one versus two or more comorbidities (p=0.96), and full and partial rehabilitation program (p=0.80). Difference was not found in mRS score progress according to the

severity of the affected side paralysis, i.e. hemiplegia or hemiparesis ($p=0.06$), although the improvement was more in favor of hemiparetic patients (1.03 ± 0.66) than hemiplegic patients (0.69 ± 0.60). The length of stay of hemiplegic patients (44 ± 11 days) was appropriately longer than in hemiparetic patients (29 ± 12 days; $p<0.001$).

DISCUSSION

Results of the study demonstrated significant functional gains in rehabilitation process of stroke patients as assessed by mRS. Although admission to rehabilitation after stroke was in most patients appropriate (31 ± 25 days), there were some too early (e.g., 7-9 days) or too late admissions (e.g., 120 or 164 days from stroke). Patients presented with higher mRS scores at rehabilitation initiation (4.07 ± 1.00) indicating high dependence and need of thorough approach and commitment of the whole rehabilitation team, including occupational and speech therapy as well as basic kinesitherapy (2). Moreover, the presence of comorbidities and risk factors in the majority of patients contributed to the complexity of rehabilitation process (10). Some patients were restricted from full program because of contraindications (e.g., the program did not include hydrokinesitherapy). Patients made a statistically significant improvement in the course of rehabilitation (mRS score at end was 3.10 ± 1.18 , $p<0.001$) with a mean difference in mRS score of 0.97 ± 0.66 . This indicates change in one level of independence and important functional gains, e.g., from: "unable to walk without assistance and unable to attend to own bodily needs without assistance" in score 4 to: "requiring some help, but able to walk without assistance" in score 3; or from score 3 to score ≤ 2 , which corresponds to independence. As expected and more demanding, initial mRS score at rehabilitation initiation was higher in patients aged over 65 (Fig. 1), hemiplegic patients (Fig. 2) and patients with two or more comorbidities (Fig. 3). The need of focused rehabilitation care in hemiplegic patients was confirmed by a significantly longer length of stay (44 ± 11 vs. 29 ± 12 days) necessary to achieve similar mRS score improvement as in hemiparetic patients ($p=0.06$), although still slightly more in favor of hemiparetic patients (1.03 ± 0.66 vs. 0.69 ± 0.60). This means that rehabilitation efforts are valuable in all patients and should be indicated according to the actual rehabilitation needs. Similarly, regardless of the severity of paralysis, the length of stay was longer in patients with higher initial mRS score and shorter (up to 21 days) in patients with lower

scores (Fig. 4). The mRS score improvement was evident in all groups of patients, but there was no statistical difference between patients arriving to rehabilitation before or after post-stroke day 30 ($p=0.32$), or between patients with the length of stay up to and more than 21 days ($p=0.09$) (Table 5), indicating that rehabilitation was initiated timely and prolonged up to the needs of patients. A recent comparison of Bulgarian and Croatian stroke patients showed significantly better results in mRS improvement in Croatian patients (0.96 ± 0.67) compared to Bulgarian patients (0.42 ± 0.50), with appropriately longer length of stay, which was 33 ± 15 days for Croatian patients and 8 ± 2 days in Bulgarian sample (11). There were no differences in mRS progress between patients according to the side involved, type of stroke, gender, age at stroke, comorbidities, or type of program, again proving that rehabilitation interventions may be of help in all groups of patients. Stroke patients require calm environment with structured rehabilitation effort of the multidisciplinary team, and length of stay that allows for the expected variations of their physical, psychological and motivational state, which occur over days and weeks (2,3).

CONCLUSION

Individually adjusted rehabilitation efforts, if initiated on time and to the extent of the rehabilitation needs of the patients, proved useful in all stroke patients regardless of their age, comorbidity and type and severity of stroke, with the judicious use of available resources.

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Ishod moždanog udara pacijenata u Hrvatskoj mjeren modificiranom Rankinovom ljestvicom

SAŽETAK - Cilj ovoga istraživanja bio je mjerenje funkcijskih ishoda bolesnika nakon moždanog udara tijekom rehabilitacije u hrvatskom centru za rehabilitaciju uz primjenu modificirane Rankinove ljestvice (mRS). Analizirani su podaci 90 bolesnika s moždanim udarom u 2010. i 2011. godini prema spolu, dobi u vrijeme moždanog udara, danima od udara do početka rehabilitacije, tipu, lateralizaciji i težini udara, duljini boravka na rehabilitaciji, komorbiditetu i programu rehabilitacije. Bilježeni su početni i završni rezultati mRS te promjene (napredak) u bolesnikovim funkcijskim sposobnostima. Bolesnici su na početku rehabilitacije imali rezultat mRS ($4,07 \pm 1,00$) koji je ukazivao na veću ovisnost, a bio je veći u bolesnika starijih od 65 godina ($4,21 \pm 0,97$), u hemiplegičnih bolesnika ($4,94 \pm 0,25$) i u bolesnika s dva ili više komorbiditeta ($4,27 \pm 0,79$). Duljina boravka je bila duža od 21 dana kod bolesnika s većim početnim rezultatom mRS ($4,61 \pm 0,64$). Rezultat mRS nakon rehabilitacije bio je $3,10 \pm 1,18$ sa značajnim funkcijskim oporavkom od $0,97 \pm 0,66$. Također, kod svih podskupina bolesnika zabilježen je značajan funkcijski napredak mjenen pomoću mRS. Duljina boravka hemiplegičnih bolesnika (44 ± 11 dana) bila je primjereno veća no u hemiparetičnih bolesnika (29 ± 12 dana) ($p < 0,001$) uz postizanje sličnog napretka u rezultatu mRS ($p = 0,06$), premda malo u korist hemiparetičnih bolesnika ($1,03 \pm 0,66$ prema $0,69 \pm 0,60$). Zaključuje se da su rehabilitacijski postupci bili vremenski i opsegom sukladni individualnim potrebama bolesnika te se pokazali korisnima u svih bolesnika bez obzira na njihovu dob, komorbiditet, tip ili težinu moždanog udara.

Ključne riječi: ishodi, modificirana Rankinova ljestvica, moždani udar