

Effects of selected factors on the outcome of rehabilitation of post-stroke patients

Wpływ wybranych czynników na efekty rehabilitacji u chorych po udarze mózgu

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Keywords

stroke, evaluation of patients clinical status, rehabilitation complexity, rehabilitation results

Abstract

The aim of the study was to evaluate the impact of selected factors, such as: gender, age, stroke type, side of paresis, time to initiation of rehabilitation, first or successive in-patient rehabilitation and severity of paresis at admission on the final clinical status of patients and on the outcome of treatment at the department of rehabilitation, district hospital.

Material and methods: All 431 post-stroke patients qualified for the treatment at the department of rehabilitation between January 2002 and December 2003 were included in the study. Patients were divided into four age groups. Results of rehabilitation were analyzed in male and female groups separately. Patients were divided according to the stroke type into four groups either suffering from an ischaemic or a hemorrhagic stroke; another selection criterion was left-sided vs. right-sided paresis. The so-called general fitness, Barthel Index and Brunnström test were used to evaluate clinical status of the patients and the progress of rehabilitation. Statistical analysis was carried out using the t-test or – alternatively – the non-parametric Wilcoxon signed rank test, analysis of variance (ANOVA) or the non-parametric Kruskal-Wallis test, and the chi-square test.

Results: Based on the obtained results, it was proven that multidimensional, complex rehabilitation in a specialist centre, carried out by rehabilitation team resulted in significant improvement of post-stroke patients' clinical status. The improvement was observed for all measurements of fitness used in the study. Analysis of the effects of rehabilitation with regard to patients' age indicated that an improvement in general fitness, motor activity (reduction of paresis) and independency in activities of daily living was obtained in each age group. Based on the analysis conducted in groups of patients with different stroke aetiologies, it was found that effects of the treatment in patients with haemorrhagic stroke were better than in patients with ischaemic stroke, which was observed in each of the applied measures used for the evaluation of patients' clinical status. Mean improvement observed after the treatment was greater in patients with right-sided paresis than in patients with left-sided paresis. Gender had no significant effect on the extent of rehabilitation results.

Conclusions: Results of the study indicate that in post-stroke patients, gender, advanced age, stroke location, stroke type or motor skills at admission do not constitute a criterion determining the possibility of conducting rehabilitation procedures.

Słowa kluczowe

udar mózgu, ocena stanu chorych, rehabilitacja, kompleksowość, wyniki rehabilitacji

Streszczenie

Cel pracy: Celem pracy była ocena wpływu płci, wieku, rodzaju udaru mózgu, strony niedowład, na efekty rehabilitacji w oddziale rehabilitacji szpitala wojewódzkiego.

Materiał i metody: W okresie od stycznia 2002 roku do grudnia 2003 roku w oddziale rehabilitacji leczono 431 chorych po udarze mózgu. Badanych podzielono na cztery grupy wiekowe. Oddzielnie przeanalizowano efekty rehabilitacji u kobiet i mężczyzn. Ze względu na rodzaj udaru mózgu dokonano podziału na chorych z udarem niedokrwiennym i krwotocznym, na chorych z niedowładem lewostronnym i prawostronnym. W ocenie stanu chorych i postępów w przebiegu rehabilitacji wykorzystano tzw. sprawność ogólną, test Brunnström, wskaźnik Barthel. Wyniki opracowano statystycznie wykorzystując alternatywny test nieparametryczny Wilcozona, modele jedno- i wieloczynnikowej analizy wariancji (ANOVA), test nieparametryczny Kruskala-Wallisa, test niezależności chi-kwadrat.

Wyniki: Analiza efektów rehabilitacji w zależności od wieku wykazała, że poprawa sprawności ogólnej, stanu ruchowego (zmniejszenie niedowład), oraz samodzielności w czynnościach dnia codziennego odnotowywana była we wszystkich grupach wiekowych. Analizując uzyskane wyniki w zależności od rodzaju udaru mózgu stwierdzono, iż uzyskane efekty u chorych po udarze krwotocznym były lepsze niż u chorych z udarem niedokrwiennym, co odnotowano we wszystkich stosowanych miarach oceny stanu chorych. Chorzy

Authors' contribution: A – project of the study, work; B – collection of the data, information; C – statistical analysis; D – data interpretation; E – preparation of the manuscript; F – literature query; G – obtaining funds

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z niedowładem prawostronnym uzyskali większą średnią poprawę po leczeniu, niż chorzy z niedowładem lewostronnym. Przynależność do kategorii płęć nie ma znaczącego wpływu na wielkość efektu rehabilitacji.

Wnioski: Z badań wynika, że płęć, zaawansowany wiek, lokalizacja ogniska udarowego, rodzaj udaru mózgu, nie stanowią kryterium decydującego o możliwości podjęcia rehabilitacji.

Introduction

Cerebral stroke (CS) is one of the most frequent neurological diseases. Because of high mortality an initial disease stage, multi-directionality and long-term character of therapy and rehabilitation, CS constitutes an important medical and social problem.

Sequels of CS, such as paresis, speech disturbances, cognitive and intellectual dysfunction result in an inability of a great number of patients to function independently and these patients require assistance of other persons in performance of daily life activities. The fact that CS is characterised by high incidence, various aetiopathogenesis and increasing prevalence among young, professionally and socially active people, contributes to an even greater complexity in dealing with this interdisciplinary problem.^{1,2,3,4,5,6,7,8,9}

Many authors concentrate more extensively on obtaining detailed information on CS therapy and the related costs. Such knowledge is essential when planning health care services, including rehabilitation^{10,11,12,13,9}.

Feigin et al.¹⁴ conducted an overview of literature pertaining to a significant number of studies on the incidence and mortality associated with stroke, published in the last decade of the 20th century. They analysed CS prevalence in relation to age, CS type, gender, geographic differences and concluded that the majority of authors observed a reduction or lack of changes in mortality during the early phase of stroke in studies conducted within the last 20-30 years. Official mortality data collected from over 25 countries showed that the rate of deaths due to CS has been decreasing for several decades, especially in Japan, North America and Western Europe. The analysis demonstrates that in many countries, mortality started to decrease beginning with the early 50-ties, yet, the rate of this decrease has recently begun to fall. The commonly observed phenomenon of population

aging is the most probable explanation of this finding.

The observed systematic reduction in mortality and disability associated with CS is mainly due to spread of proper principles of therapy and rehabilitation in patients with CS that have been introduced since the beginning of the 70-ties in countries of Western Europe and USA. However, the tendency is observed in Poland still at a too low rate. Therefore, the problem of prevention, diagnosis, treatment and rehabilitation of patients with CS is so important in our country¹⁵.

Aim of the study

1. To assess the degree and range in which complex rehabilitation affects reduction of paresis and improvement in independent activities.
2. To evaluate the effects of rehabilitation in post-stroke patients in relation to gender, age, stroke type, side of paresis.

The study was approved by local Bioethical Committee of Regional Chamber of Physicians in Rzeszów.

Qualification for in-patient rehabilitation

The patients were admitted to the rehabilitation ward directly from the neurology ward, following a qualification procedure conducted by a physician, a medical rehabilitation specialist, as well as from rehabilitation outpatient clinic, also following qualification conducted by a physician from the rehabilitation ward.

Inclusion criteria

All patients who had cerebral stroke and were qualified for hospitalisation at the rehabilitation ward were enrolled into the study.

Exclusion criteria

At the Neurology Ward, rehabilitation adjusted to current clinical status was conducted in post-stroke patients

according to generally recognised guidelines.

Main contraindications for continuation of therapy at rehabilitation ward included: uncompensated heart failure, respiratory disturbances, persistent inflammatory states accompanied by high fever, marked, deep decubitus, lack of at least minimum motivation for cooperation in physiotherapy, speech exercises and psychotherapy. However, these contraindications were of transient nature and were continuously monitored to select most suitable time to transfer the patients to the Rehabilitation Ward.

Methods of inpatient rehabilitation

Upon admission to the ward, each patient was assigned an individual rehabilitation program, adjusted to patient's physical fitness, mental status and observed neurological deficits. The program was verified by the rehabilitation team.

Program of rehabilitation exercises in dependent patients comprised morning gymnastics, passive and active respiratory exercises, vascular exercises of the lower extremities, occupational therapy. Rehabilitation procedures aimed at gradually bringing the patient to the upright position, including use of tilt table when needed, para-vertical, static or dynamic parapodium were performed. With improving health status, individual exercises at gymnastic halls were applied: on a bicycle, treadmill, at unloading and exercises with use of various instruments. During further process of improvement in motor functions and locomotion, patients performed group exercises in a sitting and supine position, rhythmic exercises, were learning how to walk outdoors and on stairs. Exercises performed as part of the occupational therapy were emphasised, with special attention drawn to teaching the patients independence in daily living and to manipulative exercises. Modern methods of biofeedback, a plat-

form, signalling ball and STEP device were used for balance exercises and gait learning.

Physical methods such as: manual, pneumatic, spin massages, warmth therapy, cryotherapy, ultrasounds, therapy with electrical current, impulse electromagnetic field, magnetic field were used in all patients as preparation for exercises and as required. When needed, rehabilitation program was supported by individual psychotherapy and speech learning. Physiotherapy was used for six days a week.

In each patient, forms of social rehabilitation were also introduced that included contact with patient's family and social environment (visits of friends, part-time home visits) and cooperation with local authorities; these activities were conducted in order to ensure appropriate social and financial support for the patients. If needed, attempts were made to place a patient in a long-term care ward or in a nursing home.

Appropriate orthopaedic instrumentation was planned and delivered for all patients at the beginning of their hospitalisation, which served to properly conduct rehabilitation program and to improve patients' quality of life. Dependently on the needs, braces, slings, foot drop splints, hyperextension preventing devices, sticks, elbow sticks, tri- and quadripods, walkers were recommended. Patients were advised on how to adjust their flats to the new situation. Mean duration of hospital stay at the rehabilitation ward was four weeks.

Material

During the period of time from January 2002 to December 2003, 1438 patients were treated at the Rehabilitation Ward of the Wojewódzki Hospital Nr. 2 in Rzeszów. All post-stroke patients qualified for treatment in a rehabilitation ward were enrolled into the study. This group comprised 431 patients, that is 30% of all inpatients of the ward during this period of time.

The majority of studied patients were men (245 (56.8%)), while there were 186 (43.2%) women. Over half of the patients lived in rural areas (239 (55.5%)), whereas there were 192 persons (44.5%) living in urban areas.

Patient at the age of more than 60 and 70 years constituted the largest group. Mean age of all rehabilitation patients was 62.7 years. The youngest patient was 16 years old, the oldest – 88 years old. For the purpose of this study, four age groups were distinguished. The first included patients up to 49 years old, the second comprised patients aged from 50 to 59 years, the third – patients aged from 60 to 69 years, the fourth group comprised patients who were older than 69 years.

In the evaluated group, the majority of younger patients were males. Percentage of men and women was similar for ages 60 to 70 years, while there were more females than males in the group of patients older than 70 years.

Patients were divided into two groups depending on the type of stroke (haemorrhagic, ischaemic). The majority, 318 (73.8%) patients had ischaemic stroke, including 133 females (41.8%) and 185 males (58.2%). Haemorrhagic stroke had occurred in 113 patients (26.2%). There were 53 women (46.9%) and 60 men (53.1%) among these patients.

Left-sided stroke signs were found in 209 (48.5%) patients, including 60 (28.7%) patients with haemorrhagic and 149 (71.3%) with ischaemic stroke. Right-sided paresis was observed in 222 (51.1%) patients, with 53 (23.9%) patients who had had haemorrhage and 169 (76.1%) post-ischaemic stroke patients. The majority of patients with left- and right-sided paresis were male.

Because of the time span since the first signs of stroke to initiation of rehabilitation, patients were divided into three groups – with rehabilitation initiated up to one month following stroke, from the second to the twelfth month after stroke and the third group – with rehabilitation started later than one year after stroke onset. The largest group included patients hospitalised at the rehabilitation ward before the end of the first month following stroke – 173 (40.1%), while there were 146 patients (33.9%) in the one-year post-stroke group and 112 patients (26%) who were admitted to the rehabilitation wards after a period longer than one year following stroke. However, these characteristics were not analysed in detail in this work.

Methods of assessment of patients' clinical status

Assessment of patients' clinical status at a rehabilitation ward is complex and includes: medical history and physical examination, additionally with neurological examination, physiotherapeutic examination of the locomotor system, psychological assessment, logopedic assessment, assessment referring to the nursing care, determination of patient's and his family social situation by a social worker, evaluation of spasticity according to the modified Ashworth scale, assessment of functional status – capability of independent locomotion, a gait test and two scales test in patients who were able to stand, evaluation using functional scales applied in post-stroke patients. The complex evaluation is supplemented by informations from the "assessment and progress of rehabilitation chart for patients with hemiparesis" used at the ward^{16,17}.

In the study, the following indices were used:

- The Brunnström test for the assessment of the severity of paresis, taking into account evolution of spasticity (expressed as point values).
- The ADL Barthel Index for the assessment of independence in functioning (points)
- General fitness to evaluate the potential of independent functioning of post-stroke patients (points). General fitness comprises the sum of points scored in a complex assessment including contact with the environment, mental status, sphincter function, cardiovascular system functioning, functional status. Results of assessment of each of particular components of patient's current status are scored from 1 to 6, with intermediate scores every 0.5 point. This evaluation constitutes Kwolek's authorial scale that has been used at the rehabilitation ward for over twenty years to assess clinical status of post-stroke patients and evaluate effects of rehabilitation in this group of patients^{16,17}.

Statistical analysis of the effects of rehabilitation

1. To assess the statistical significance of improvement in patients'

status during the therapy, the t-test for dependent samples was used that compared various measures of agility at the end and at the beginning of the therapy; alternatively, a non-parametric Wilcoxon signed rank test was applied.

2. Test probability p is the result of a statistical test – the following principles are assumed: if $p < 0.05$ (*), differences are considered statistically significant, if $p < 0.01$ (**), the significance is considered strong, while $p < 0.001$ constitutes a very strong statistical significance (***).
3. To assess the effects of the independent variables such as type of stroke, side of paresis, age, gender on progress of rehabilitation, models of one way- and multiple-factor analysis of variance (ANOVA) were applied. As measures of agility, results of the Brunnström test, general fitness test and of the ADL Barthel Index were used.
4. Correctness of the conclusions drawn was analysed using an alternative, non-parametric, Kruskal-Wallis test.
5. Inter-relationships among the independent factors were studied using the chi-square test of independence.

Interpretation of descriptive statistics determined for the numeric variables evaluated in this study:

- arithmetic mean (\bar{x}),
- median – half of measured variables are lower while half of them – greater than the median value,
- the maximum (Max) and the minimum (Min) value,
- lower and upper quartile (Q_{25} and Q_{75}) – $1/4$ of the measured data are situated at the level of or below the lower quartile; $1/4$ of the measured data are situated at the level of or above the upper quartile,
- standard deviation (s) – constitutes a measure of „average” deviation from the mean value.

Results and discussion

In the Table 1, numeric characteristics of distributions of measures of agility used in patient assessment prior to and after the rehabilitation are summarised, as well as the improvements (changes) in agility assessed in the group of 431 patients. An

Table 1

List of descriptive statistics applied for the estimation of rehabilitation outcome							
Measure of fitness	\bar{x}	Median	Min.	Max.	Q_{25}	Q_{75}	s
Brunnström test (before)	8.21	7.5	3.0	16.5	5.0	11.5	3.80
Test Brunnström (after)	9.38	9.0	3.0	18.0	6.0	13.0	4.01
Test Brunnström (change)	1.17	1.0	-1.0	8.0	0.0	1.5	1.33
General fitness (before)	19.24	20.5	7.0	28.5	15.5	23.0	4.69
General fitness (after)	20.36	21.0	8.0	28.5	17.5	23.5	4.20
General fitness (change)	1.12	0.5	-4.0	8.5	0.0	1.5	1.60
Barthel Index (before)	8.83	9.0	0.0	20.0	3.0	13.0	5.99
Barthel Index (after)	12.07	12.0	0.0	20.0	8.0	17.0	5.60
Barthel Index (change)	3.25	3.0	-8.0	16.0	1.0	5.0	2.97

improvement in patients’ status after completion of rehabilitation is observed in all the applied measures of agility. It is noteworthy that in the majority of cases, the median is lower than the mean value, which suggests certain right-sided shift of the distribution of variables. Practically, this means that there are a few persons, where exceptionally high effects of rehabilitation were noted and that there is a relatively large group with small effects. The greatest mean value of improvement was observed in the Barthel Index, a lower value in the Brunnström test and the lowest – in the general fitness test (Table 1).

Results of the statistical tests applied unequivocally confirm that the improvement achieved in patients after the rehabilitation is statistically significant. This is reflected in the results of the t-test and the Wilcoxon signed rank test conducted as a parallel, control assessment (Table 2).

In the Table 3, there are 95% confidence intervals for the effects of treatment expressed in the three applied measures of agility. This signifies that we are allowed to state with a 95%-confidence that the average (expected) effect of the therapy falls into the given interval of values.

Table 2

Statistical significance of the improvement in patients’ clinical status after the rehabilitation							
Measure of fitness	\bar{x}	s	Result of the t-test		Result of the Wilcoxon test		
			t	p	Z	p	
Brunnström test (change)	1.17	1.33	18.2	0.000***	14.8	0.000***	
General fitness (change)	1.25	1.60	14.6	0.000***	14.1	0.000***	
Barthel Index (change)	3.25	2.97	22.7	0.000***	16.1	0.000***	

Evaluation of the influence of independent variables of the effects of rehabilitation

Gender

In case of the independent variable – gender, better rehabilitation effects were observed in women, which was evident in the assessment with the Brunnström test and the general fitness test. When analysing the Barthel Index, a greater progress in the improvement of patients’ status after the rehabilitation was observed in males (Table 4). However, the analysed factor does not significantly affect the magnitude of the effect of rehabilitation. Although the ANOVA demonstrated slight statistical significance for the Brunnström test, results of the Kruskal-Wallis test did not confirm this observation (Table 5).

Age

In the evaluated group, age is a factor that majorly determines final effects of rehabilitation (Table 6). Analysis of the mean values shows that this effect primarily involves a relatively greater improvement in agility among patients from the youngest

Table 3

Confidence intervals of improvement gained		
Measure of fitness	95% parametric confidence interval for therapy outcome	
Brunnström test (change)	1.04	1.29
General fitness (change)	0.96	1.55
Barthel Index (change)	2.96	3.53

Table 4

Relationship between rehabilitation outcome and gender						
Gender	Brunnström test (change)		General fitness (change)		Barthel Index (change)	
	\bar{x}	s	\bar{x}	s	\bar{x}	s
Males	1.06	1.21	1.06	1.56	3.34	2.94
Females	1.32	1.47	1.20	1.64	3.12	3.02

Table 5

Statistical evaluation of the relationship between rehabilitation outcome and gender		
Rehabilitation outcome	ANOVA test	Kruskal-Wallis test
Brunnström test	0.044*	0.111
General fitness	0.350	0.138
Barthel Index	0.457	0.465

Table 6

Relationship between rehabilitation outcome and patients' age						
Age group	Brunnström test (change)		General fitness (change)		Barthel Index (change)	
	\bar{x}	s	\bar{x}	s	\bar{x}	s
Up to 49 years	1.45	1.49	1.72	2.03	4.11	3.27
50-59 years	1.03	1.17	1.10	1.82	2.96	2.47
60-69 years	1.23	1.34	0.92	1.12	3.20	2.75
70 or above	1.07	1.33	1.06	1.56	3.10	3.27

Table 7

Statistical evaluation of the relationship between rehabilitation outcome and patients' age		
Rehabilitation outcome	ANOVA test	Kruskal-Wallis test
Brunnström test	0.183	0.065
General fitness	0.010**	0.022*
Barthel Index	0.085	0.134

age group. Discrepancies among the groups involve a distinction of the up-to-49 years group (better final result, Table 6). Final effects of rehabilitation for the remaining three age groups were similar in the assess-

ment using the agility measures described above (Table 6). The obtained results demonstrated that statistical significance was especially evident in the categories of general fitness (Table 7).

Type of stroke

Type of stroke constitutes a factor that significantly affects final results of inpatient rehabilitation. The conducted analysis demonstrated that the improvement in patients' clinical status after stroke occurs as a result of rehabilitation in both groups (Table 8). However, post-haemorrhagic stroke patients achieve better end-point results than those who experienced ischaemic stroke. This is observed when using three measures of agility, although not in all cases was the difference statistically significant (Table 9). The effect of stroke type on the magnitude of rehabilitation effect is very clear, when patient's status improvement is measured in categories of general fitness. Similar relationship is also seen for the remaining two measures of agility, yet the differences are not that large to be considered statistically significant.

Side of paresis

In the evaluated group, patients with right-sided paresis had better improvement after rehabilitation, which was evident for all the applied measures of patients' agility (Table 10), while the results describing the effects of side of paresis on patients' end-point clinical status were statistically significant for general fitness and the Barthel Index (Table 11).

Discussion

The aim of the study was to assess the effects of selected factors, such as gender, age, type of stroke, side of paresis on the efficacy of rehabilitation in post-stroke inpatients of a rehabilitation ward. The study was conducted because of major and still persistent sequels for the patient and his closest relatives that are associated with occurrence of stroke. Further, large costs for the healthcare system and the whole society were another prerequisite for this study. We concluded that it is necessary to investigate the effects of selected factors characterising post-stroke patients' status on admission to a rehabilitation ward on final effects of re-

Table 8

Effect of the type of cerebral stroke on rehabilitation outcome						
Type of stroke	Brunnström test (change)		General fitness (change)		Barthel Index (change)	
	\bar{x}	s	\bar{x}	s	\bar{x}	s
Haemorrhagic	1.38	1.59	1.63	2.04	3.55	3.19
Ischaemic	1.09	1.22	0.94	1.36	3.14	2.89

Table 9

Statistical evaluation of the effect of stroke type on rehabilitation outcome		
Rehabilitation outcome	ANOVA test	Kruskal-Wallis test
Brunnström test	0.044*	0.134
General fitness	0.000***	0.001**
Barthel Index	0.208	0.137

Table 10

Effect of side of paresis on rehabilitation outcome						
Side of paresis	Brunnström test (change)		General fitness (change)		Barthel Index (change)	
	\bar{x}	s	\bar{x}	s	\bar{x}	s
Right	1.27	1.37	1.31	1.68	3.55	3.18
Left	1.06	1.28	0.92	1.48	2.92	2.71

Table 11

Statistical evaluation of the assessed relationship (left-sided vs. right-sided paresis)		
Rehabilitation outcome	ANOVA test	Kruskal-Wallis test
Brunnström test	0.116	0.108
General fitness	0.011*	0.014*
Barthel Index	0.029*	0.032*

habilitation in these patients. In other words, in this study, we attempted to find an answer to questions frequently asked by physicians, physiotherapists and healthcare system authorities that should not remain unanswered. These include: when to start rehabilitation treatment, how does patient's age affect final results, are the effects better in women or in men, are they better in haemorrhagic or ischaemic stroke, what will the end-point result be in patients with right- versus left-sided hemiparesis, is it worth conducting rehabilitation in post-stroke patients?

The analysis of inter-relationships among age, rehabilitation and its mean results after its completion shows that the improvement was observed in all age groups and was most pronounced for general fitness. General fitness comprises such domains as: mental status, ability to communicate with the environment, cardiovascular system status, function of the sphincters and general functional status. The function that substantially affects the possibility of patients' independent functioning after stroke was improved thus contributing to better quality of life of

patients undergoing rehabilitation and their families.

Analysis of mean results shows that relatively greatest improvement is observed in the youngest age group, which was statistically significant in the categories of general fitness and the ADL Barthel Index. Teasell et al.¹⁸ states that the very youngest patients who survived cerebral stroke have most pronounced psycho-social problems including breaking relationships with their partners, loss of job, or difficulties in bringing up their children. Yet, the improvement is evident in all age groups in all the applied measures of agility and patients at the age of 60 to 69 years even showed better effects of rehabilitation than patients aged 50 to 59 years, 70 and above – this was observed in the Brunnström test and the ADL Barthel Index. Similarly, patients aged 70 years or more demonstrated a greater improvement in the Brunnström test and the ADL Barthel Index than patients who were 50 to 59 years old. In general fitness assessment, better effects were observed in patients who were older than 70 years than in those aged from 60 to 69 years. Inouye reports that best rehabilitation effects assessed in the FIM (Functional Independence Measure) scale in 464 patients treated in Japan were observed for age interval 60-69 years¹⁹.

The obtained results demonstrate that final effects are independent of age and constitute an unequivocal evidence justifying conduction of consequent, complex rehabilitation in elderly people. Based on the conducted analysis, it can be concluded that advanced age is not a contraindication for rehabilitation in post-stroke patients^{20,21}.

Pohjsavaara et al.²² report that the number of risk factors for cerebral stroke increasing with advanced age (atherosclerosis, heart diseases) are certain problem in post-stroke rehabilitation. These authors divided their group of 486 patients into two age groups: 55-70 and 71-85 years. They evaluated those patients using the ADL Barthel Index before stroke and three months after cerebral stroke, while taking into account the number of concomitant diseases (greater for

the older persons). The authors concluded that the status of the older patients was worse before stroke. In this group, cerebral strokes had a more dramatic course and to a significantly greater extent reduced general fitness than in case of the younger patients.

The number risk factors for stroke in the evaluated group proved to be very strongly determined by patients' age ($p=0.000^{***}$). For the youngest patients, it was 2.78, in the 50-59 years age group – 3.4, in the 60-69 and above 70-year group – it was similar and was 3.91 and 3.94 per patient respectively. The increasing number of risk factors present in older patients does not constitute a contraindication for initiation of rehabilitation; however, it requires closer cooperation with physicians from acute wards and family physicians in order to appropriately prepare such patient for the rehabilitation process. Moreover, the rehabilitation program conducted at the ward in the group of older patients, with more risk factors, should be maximally individualised and consider principles of graded introduction of rehabilitation components.

Evaluation of inter-relationships among age and type of stroke also showed that the prevalence of ischaemic stroke increased with age. This relationship is very strong ($p=0.000^{***}$). In the group of 318 patients with ischaemic stroke, aged up to 49 years, there were 34 patients (54%), whereas the group aged 70 or more years included as many as 124 (84%) of patients.

Both in the post-ischaemic and post-haemorrhagic stroke group, an improvement was observed in all the applied agility measures, yet, markedly significant improvement was achieved in the domain of general fitness. It was observed that patients with haemorrhagic stroke achieved significantly better effects than those with ischaemic stroke, which corresponds to the data from the literature^{23,24,25,26,27}. In the studied group, a marked relationship ($p=0.000^{***}$) is present between the type of stroke and age group. Prevalence of ischaemic stroke is greater than that of haemorrhagic stroke in the older age groups, which may partially explain

the observed marked difference in the effects of rehabilitation for this parameter (better effects in the haemorrhagic stroke group). The relationship is confirmed by observations of the effects of age on final rehabilitation results described above. Greater number of risk factors for stroke – 2.96 per patient for ischaemic stroke and 3.89 for haemorrhagic stroke – was associated with worse results of post-stroke rehabilitation. In a study of Kelly et al.²⁸, it was shown that functional impairment was greater in haemorrhagic than in ischaemic stroke on admission, while effects of rehabilitation were better in patients with haemorrhagic stroke. When degree of stroke-associated lesion was similar in both groups, the improvement was greater in patients with haemorrhagic stroke than in those with ischaemic stroke.

In the evaluated group of 431 patients, the majority were men – 56.8%, while there were 43.2% of women. Gender did not significantly affect rehabilitation effects. Women demonstrated greater improvement in clinical status assessed in the Brunnström test and in the general fitness test at the end of treatment, while men showed better results in the ADL Barthel Index. These results were not statistically significant. Similarly, some authors do not consider gender to be a factor determining prognosis of rehabilitation results in post-stroke patients^{29,30}. However, Wyller et al.³¹ reports that their analyses of effects of rehabilitation with regard to sex showed that it was men, who had significantly better results than women. In the study by Glader et al.³², women who had had stroke were found to have poorer results of rehabilitation than men. According to the authors, this could have been due to worse clinical status before stroke associated with a greater number of concomitant diseases and older age of women than men.

Roquer et al.³³ conducted a study between December 1995 and January 2002, where they analysed presence of possible gender-associated differences in general health status in a group of 1581 patients after the first ischaemic stroke ever in their lives. It was shown that sex determines existence of marked discrepancies among

post-stroke patients. Women were older than men by 6 years on average, had other risk factors. Arterial hypertension, diseases of the heart were independent female gender-associated risk factors, whereas alcohol abuse and smoking were the risk factors that were related to male gender. Females more frequently had aphasia, visual field disturbances and dysphagia. In women, there was a higher incidence of cardio-embolic strokes, while men more often had strokes due to thrombosis. Moreover, women stayed longer in the hospital and their post-stroke functional status was poorer than in men. It is possible that the described differences in gender effects and clinical status of post-stroke patients contribute to the diversity of the obtained results of rehabilitation presented by various authors.

In the analysis of this factor (sex), it is difficult to find significant relationships that could prove any influence on rehabilitation effects. Both men and women more frequently have ischaemic strokes. Based on the conducted studies, it was demonstrated that ischaemic stroke is associated with poorer outcome. Percentage of ischaemic strokes is 75.51% in men and 71.51% in women. The slight difference in these percentages is a consequence of the random selection of the sample and not of a general tendency – this is supported by the insignificance of the independence test: $p=0.349$. Evaluation of inter-relationships between gender and side of paresis did not demonstrate any significant differences in the obtained results ($p=0.876$). It is noteworthy that right- and left-sided hemiparesis were almost equally frequent. Right-sided hemiparesis was observed in 51.84% of males and in 51.08% of females, while left-sided hemiparesis occurred in 48.16% of men and 48.92% of women. Further analysis shows that patients with right-sided hemiparesis had better results. Age at stroke was the only factor associated with gender to some extent ($p=0.042^{**}$). In the oldest age group, there were more women. In the 70 and above years group, women constituted 40.32% and men – 28.16%. These relationships are also confirmed by the ob-

servations of the factor – age. However, it seems that this phenomenon can be partially explained by a shorter mean life span of men and thus a more frequent occurrence of strokes in older women³⁴.

Analysis of differences in rehabilitation effects in patients with left- and right-sided paresis yielded interesting results. All patients with right-sided paresis achieved better improvement that was documented in the applied measures of agility. Similar views are shared by the majority of researchers^{35,36,37,38}. However, some claim that – despite single discrepancies – there are no significant differences in the effects of rehabilitation of patients with left- and right-sided paresis^{39,40,41}.

According to the current opinions, remote effects of rehabilitation significantly depend on functional hemispheric asymmetry^{39,42,43}. Left hemisphere lesion leads to disturbances in verbal memory, speech, writing and learning functions. It contributes to depressive states and impair control of complex motor activities (manipulation grip). In case of right hemispheric damage, disturbances and/or impairment of representation responsible for integration of different functions and visual-spatial coordination occur. Increased mood or apathy can occur as alternating states, as well as the neglect syndrome, reactions inducing lack of acceptance of the existing motor dysfunction. In case of a mixed damage, various combinations of the described symptoms and signs can occur^{42,44,45}. Therefore, the functional asymmetry combined with presence of ischaemic focus in particular hemisphere manifesting as right- or left-sided hemiparesis may be important in improvement of motor function⁴⁵. Effect of the side of paresis on the remote effect of rehabilitation was statistically significant for general fitness and the ADL Barthel Index. Patients with left-sided paresis and thus a lesion in the right hemisphere had worst results in the domain of general fitness, that is in the functional status, mental state or a broadly defined contact with the environment and significantly poor results for the ADL Barthel Index characterising the degree of patient inde-

pendence in the activities of daily living. Worse effects for those scales in combination with low score in the Brunnström test significantly reduce broadly defined quality of life in this group of patients. It is possible that localisation of stroke in the right cerebral hemisphere, manifesting in perception-motor disturbances, hemineglect, lack of acceptance of the existing situation and thus of motivation for rehabilitation, results in the fact that patients with left-sided hemiparesis achieve worse results despite preserved verbal contact. It should, however, be kept in mind that results mean a sum of points that is supposed to indicate an improvement in functioning and health status of patients subjected to rehabilitation treatment. Therefore, patients with left- and right-sided hemiparesis should be treated with same determination.

Conclusions

From the conducted study, the following can be concluded:

1. Complex rehabilitation conducted in a specialised centre by a rehabilitation team resulted in a significant improvement in clinical status of post-stroke patients.
2. Results of the complex therapy in post-stroke patients did not depend on gender.
3. Effects of rehabilitation did not depend on patients' age, with exception of patients younger than 50 years, where the results were markedly better than in the remaining groups. Advanced age does not constitute a contraindication for conduction of rehabilitation therapy.
4. In the post-haemorrhagic stroke group, effects of rehabilitation were better than in post-ischaemic stroke patients. Favourable outcome of rehabilitation was observed in all the applied measures of patients' status; however, type of stroke significantly affected results of rehabilitation only in the general fitness category.
5. Patients with lesion in the left hemisphere had better rehabilitation results for general fitness and the Barthel Index.

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