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Rehabilitation following stroke in patients aged 85 and above

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Abstract—To assess the course and results of rehabilitation following stroke in patients aged 85 and above, we conducted a prospective study to compare 45 patients 85 years and above and 220 consecutive patients aged 75 to 84 years who were hospitalized for rehabilitation following stroke. Functional status was measured and compared by the Functional Independence Measure™ (FIM) scale and successful rehabilitation was defined as FIM > 80 at discharge. Eighteen patients in the 85+ group (40%) underwent successful rehabilitation compared with 115 (52%) in the 75 to 84 group (not significant). No significant differences were found between the groups in any other parameters that measure success and/or efficacy of rehabilitation, but in all these parameters, without exception, lower values were found in the 85+ group. No differences in the length of rehabilitation and complications rates were found between groups. We conclude that although the success rate for rehabilitation following stroke is lower in patients aged 85 and above, it appears that the effort invested in rehabilitating patients in this group is no less justified than in younger elderly patients.

Key words: efficacy, elderly, FIM, functional status, hospitalization, oldest old, rehabilitation, stroke.

INTRODUCTION

Stroke is common in the elderly population and many survivors require rehabilitation. The goal of rehabilitation is to enable elderly patients to return as closely as possible to their premorbid functional status.

Since the prevalence of stroke increases with age [1] and life expectancy has increased over the past decades, a corresponding increase exists in the age of stroke patients. The effect of age on the outcome of rehabilitation has been studied in the past. In most cases, increased age had a negative effect on rehabilitation outcome [2–6], but some studies did not find this effect [7–9]. The age of patients included in these studies was generally limited to 80 years, most probably because very few patients over this age undergo rehabilitation. Various aspects of stroke in the oldest old (demographics, risk factors, clinical presentation, use of resources, and 3-month disability) were investigated in a comprehensive European study, but the success rate of inpatient rehabilitation was not one of them [10]. Two recent studies that assessed the functional outcome of these patients compared to a younger group of elderly patients concluded that some of the oldest old patients can be successfully rehabilitated but that, as a group, measures of rehabilitation success are lower [11–12].

In light of these studies, and to expand the database in this area, we conducted a prospective study to assess the course and outcome of inpatient rehabilitation following stroke in the 85+ age group, compared with a group of younger elderly patients.

Abbreviations: FIM = Functional Independence Measure, SD = standard deviation.

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METHODS

Patients

The study population consisted of patients 75 years and older hospitalized in the geriatric ward of the Soroka Medical Center in Beer-Sheva, Israel, for rehabilitation following stroke in the 86 months between March 1, 1996, and April 30, 2003. Prior to their transfer to the geriatric department, all patients were hospitalized in the neurology department of the same medical center in the immediate poststroke period. During their hospitalization in the neurology ward, a senior geriatric consultant examined all patients and assessed whether they were suitable for inpatient rehabilitation according to accepted criteria [13]. Only those patients found to require rehabilitation and to be reasonable candidates for relatively short-term rehabilitation were transferred to the geriatric ward, where they underwent a conventional rehabilitation program. Patients who, in the consultant's experience, might require a prolonged rehabilitation period (over 8 weeks) were referred to other rehabilitation frameworks. The rehabilitation program in the geriatric ward was identical for patients in the two age groups throughout the rehabilitation period and included 1 hour daily of physical therapy and 1 hour daily of occupational therapy for 5 days each week. The staff decided in each case whether the hour would be continuous or divided into two 30-minute sessions, one in the morning and one in the afternoon.

The Committee for Research on Human Beings (the Helsinki Committee) of the Soroka Medical Center approved the study and all patients gave informed consent before enrollment.

Study Protocol

Within 48 hours of transfer to the geriatric ward, and after giving informed consent to participate in the study, all patients or their families provided demographic information and data relating to chronic comorbidity, including smoking history. Blood samples drawn at this time were tested by conventional methods for levels of hemoglobin, albumin, urea, thyroid-stimulating hormone, folic acid, and vitamin B12. Each patient underwent a full physical examination with particular attention to the specific clinical manifestations of stroke, which were diagnosed in accordance with accepted clinical standards. A senior geriatrician and an occupational therapist conducted the examinations.

At this beginning stage of hospitalization in the geriatric department, each patient underwent a mental evaluation with the use of two conventional instruments: the Folstein Mini-Mental State Examination, with a scale ranging from 1 to 30 [14], and the clock drawing test, with a scale of 1 to 10 [15–16]. In each test, a low score represents an impaired mental status. In addition, each patient underwent an assessment of symptoms of depression with the Geriatric Depression Screening Scale, with scores ranging from 0 to 30 that reflect the severity of depression; the higher the score, the more severe the depression [17]. In these tests, aphasic patients answered the questions in writing or by nodding their heads. In tasks that required writing or drawing, patients were asked to use their unaffected hand and the examiner took the patient's condition into account. There was no problem in testing patients with severe sensory aphasia, since these patients did not meet the inclusion criteria of the study.

We performed functional assessments and evaluation of the progress of rehabilitation using the Functional Independence Measure™ (FIM) scale, which ranges from 18 to 126 and is based on a score of 1 to 7 for each of 18 different items in accordance with the level of independence for each item. Using this scoring system, a patient with totally independent function would have a score of 126 points [18]. A FIM score over 80 reflects a functional state in which assistance of only a single caregiver is required. Thus, this value at discharge was chosen to define successful rehabilitation. A senior geriatrician determined the prestroke FIM score during an interview with the patient or his/her family just before admission. FIM scores on admission to rehabilitation, during its course and at its end, were determined during a meeting of the geriatric ward medical, rehabilitation, and nursing staffs. The decision to discharge a patient at the end of the rehabilitation process was reached when FIM scores were stable at two successive determinations, 1 week apart. The length of hospitalization in the neurology department was recorded from the chart in that department. Various complications during the rehabilitation process were recorded, when they occurred, by the study staff.

Statistical Analysis

We analyzed all data for patients and measurement variables using the EPI INFO statistical software (from Windows). Continuous variables were compared between the two groups. Student's *t*-test and rates were compared

with the χ^2 statistic (or its equivalent, the Kruskal-Wallis test). Statistical significance was set as $p < 0.05$ throughout.

RESULTS

During the study period, 1,922 patients aged 65 years and older were hospitalized in the neurology department with the diagnosis of stroke based on conventional diagnostic criteria. Of these, 522 (26.2%) were transferred to the geriatrics department for rehabilitation in accordance with the protocol and indices just described.

The study group comprised 45 patients aged 85 years or older (13, aged 90–96) who were hospitalized during the study period for rehabilitation following stroke. In the same time period, 220 patients aged 75 to 84 were hospitalized for the same indication. This group served as the comparison group for the study. The mean ± standard deviation (SD) length of hospitalization in the neurology department was 9.2 ± 6.9 days for the 85+ group and 9.7 ± 7.5 for the comparison group (not significant).

Table 1 compares gender distribution and clinical characteristics of the current stroke, including the side affected by the stroke; hemiplegia (in contrast with hemiparesis); and the presence of neglect, aphasia, hemianopia, dysphagia, and sensory defects (superficial, positional, and vibration). No significant differences in any of these parameters were found between the two groups. **Table 2** shows the rates of common comorbid conditions in this age group and the number of comorbid conditions per patient. The comparison group had significantly higher rates of prior stroke ($p = 0.004$), diabetes mellitus ($p = 0.0005$), and hyperlipidemia ($p = 0.02$). No significant differences were found between the groups in other comorbid conditions or in the number of comorbid conditions per patient. Also, no significant differences were found between the groups in past or present smoking, alcoholism, chronic renal insufficiency, Parkinson's disease, joint disorders, hepatic disease, endocrine disease, or malignancy. **Table 3** presents the results of the three cognitive tests that were performed on admission to rehabilitation. No significant differences were found between the study groups in any of the tests. No significant differences were found between the groups in any of the laboratory parameters (just detailed).

Table 4 shows the complication rates and mortality during rehabilitation in the two groups. The only significant difference between the groups was in the rate of urinary tract infection, which was more prevalent in the younger group ($p = 0.01$). **Table 5** shows functional scores by FIM scale prior to the stroke, on admission to rehabilitation, and at the end of rehabilitation; the change in FIM during rehabilitation; the rehabilitation efficiency (defined as the change in FIM during rehabilitation divided by the number of rehabilitation days), and the absolute efficacy of rehabilitation defined as the change in FIM during rehabilitation divided by the difference between maximum FIM and initial FIM multiplied by

Table 1.
Comparison between 85+ and 75 to 84 age groups for gender and clinical characteristics of current stroke. No difference is statistically significant.

Variable	No. (%)		*p*-Value
	85+ (*n* = 45)	75–84 (*n* = 220)	
Gender (female)	25 (56)	118 (53)	0.77
Affected Side			
Left	28 (62)	109 (49)	0.21
Right	16 (36)	98 (45)	—
Cerebellar and Vertebrobasilar	1 (2)	14 (6)	—
Hemiplegia (in contrast to hemiparesis)	9 (20)	48 (22)	0.50
Neglect	5 (11)	41 (19)	0.22
Aphasia	13 (29)	66 (30)	0.88
Hemianopia	8 (18)	38 (17)	0.94
Dysphagia	11 (24)	40 (18)	0.33
Sensory Impairment			
Superficial	17 (38)	69 (31)	0.62
Positional	12 (27)	67 (30)	0.60
Vibration	34 (76)	139 (63)	0.14

Table 2.
Comparison between 85+ and 75 to 84 age groups for common chronic comorbid conditions.

Variable	No. (%)		*p*-Value
	85+ (*n* = 45)	75–84 (*n* = 220)	
Prior Stroke	3 (7)	59 (27)	0.004
Ischemic Heart Disease	17 (38)	93 (42)	0.58
Heart Failure	6 (13)	12 (6)	0.06
Atrial Fibrillation	10 (22)	42 (19)	0.63
Pulmonary Disease	5 (11)	23 (11)	0.54
Hypertension	29 (64)	151 (69)	0.58
Diabetes Mellitus	4 (9)	77 (35)	<0.001
Hyperlipidemia	5 (11)	59 (27)	0.02
No. of Conditions per Patient (mean ± SD)	2.6 ± 1.6	3.1 ± 1.7	0.10

SD = standard deviation

Table 3.
Comparison between 85+ and 75 to 84 age groups for cognitive tests (mental function and depression). No difference is statistically significant.

Variable	No. (%)		*p*-Value
	85+ (*n* = 45)	75–84 (*n* = 220)	
Folstein Mini-Mental State (mean ± SD)	21.0 ± 4.8	20.7 ± 6.5	0.77
Clock Drawing Test	6.6 ± 2.3	6.8 ± 2.7	0.62
Geriatric Depression Screening Scale	9.0 ± 5.5	10.0 ± 5.8	0.32

SD = standard deviation

Table 4.
Comparison between 85+ and 75 to 84 age groups for rates of various complications and mortality during rehabilitation.

Variable	No. (%)		*p*-Value
	85+ (*n* = 45)	75–84 (*n* = 220)	
Deep-Vein Thrombosis	3 (7)	3 (1)	0.06
Urinary Tract Infection	8 (18)	57 (26)	0.01
Pneumonia	2 (4)	8 (4)	0.53
Bacteremia	0 (0)	2 (1)	0.69
Acute Myocardial Ischemia/Infarction	0 (0)	10 (4.5)	0.15
Additional Stroke During Rehabilitation	1 (2)	22 (10)	0.07
Mortality During Hospitalization	0 (0)	1 (0.5)	0.83

100. The table also shows the percentages of patients with discharge FIM scores above 80 (who require only mild to moderate help in activities of daily living) and the percentage of patients in whom the change in FIM between admission to rehabilitation and discharge was above 10 (indicating a significant change in activities of daily living). In none of these parameters, which reflect the success and/or efficacy of rehabilitation, was there any significant difference between the groups, but in each of these parameters, without exception, the values in the 85+ group were lower than in the 75 to 84 group. No significant difference was found between the groups in the length of rehabilitation.

DISCUSSION

Although rehabilitation following stroke in the oldest old is not unheard of in recent years, the 45 patients who made up the study population in the present study are the

Table 5.
Comparison between 85+ and 75 to 84 age groups for functional status by Functional Independence Measure™ (FIM) score prior to stroke, on admission, to and at discharge from rehabilitation, and percentage of patients discharged to their homes. No difference is statistically significant.

Variable	No. (%)		*p*-Value
	85+ (*n* = 45)	75–84 (*n* = 220)	
Prestroke FIM (mean ± SD)	117 ± 12	118 ± 13	0.39
FIM on Admission (mean ± SD)	64 ± 20	66 ± 20	0.65
Discharge FIM (mean ± SD)*	72 ± 24	77 ± 24	0.23
Change in FIM (admission to discharge) (mean ± SD)*	8 (11)	11 (13)	0.11
FIM > 80 at Discharge (*n* [%])*	18 (40)	115 (52)	0.14
FIM Change (admission to discharge) > 10 (*n* [%])*	18 (40)	117 (53)	0.12
Effectiveness of Rehabilitation*†	0.44 ± 0.52	0.59 ± 0.63	0.12
Absolute Efficacy of Rehabilitation‡	15.5 ± 18.7	20.8 ± 22.4	0.14
Discharged to Their Home (*n* [%])*	36 (80)	193 (88)	0.14
Length of Rehabilitation (days, mean ± SD)	21 ± 11	23 ± 11	0.33

*Data for these variables relate only to patients who survived hospitalization.
†Change in FIM ÷ by number of days of rehabilitation.
‡Change in FIM ÷ (maximum FIM – initial FIM) × 100.
SD = standard deviation

largest group of this age for whom results of rehabilitation following stroke have been published. Still, the size of the group was too small to provide sufficient statistical power to compare these results to the group of younger elderly patients. Because of this lack of statistical power, most of the differences did not reach statistical significance, although they point to a certain trend among some of the variables. Successful rehabilitation, the main outcome variable that was defined as FIM > 80 at discharge, was found in 40 percent of the oldest old in our study. In this parameter, as well as in other parameters of the effectiveness and success of rehabilitation (**Table 5**), the oldest old group had a clear and consistent trend toward lower values compared with the younger elderly group. This trend is consistent with the findings of two similar recent studies that were quoted in the Introduction, but in those studies the success rates for rehabilitation among the oldest old were significantly lower statistically than among the younger elderly comparison groups, even though the size of the oldest old groups in these studies was smaller than in ours. One of those studies was a retrospective comparison of 44 patients 80 years or older with 179 patients whose mean age was 62 years (range 23–79) [11]. It is logical to assume that the significantly younger comparison group in this study is the major reason that rehabilitation in that group was significantly more successful than among the oldest old group. The other study compared, among other things, the outcome of rehabilitation among 30 patients 85 years or older with 30 patients aged 75 to 84 [12]. The comparison showed a significant advantage to rehabilitation in the 75- to 84-year age group. There is a striking difference in the mean range of the hospitalization period, which was 67 to 82 days in that study, compared with 21 to 23 days in our study. This difference in the length of hospitalization may reflect a difference in the clinical characteristics of the patients who were admitted to the hospital in the two studies. In our prerehabilitation assessment, we did not admit patients who we thought would require a rehabilitation period of more than 8 weeks. These patients were included in the other study and their participation likely led to the lower success rate for rehabilitation among 85+ patients.

Three methodological issues relating to our study need to be addressed. The first is that not all patients who suffered a stroke in the two age groups were transferred for rehabilitation and included in the study. As described previously, a senior geriatrician assessed the patients before the decision was reached and only those patients with a reasonable chance for successful rehabilitation were transferred to the geriatrics ward. In borderline cases, the patient was given the benefit of the doubt and was admitted for rehabilitation. In general, patients with advanced dementia or a very poor prestroke functional state were not admitted for rehabilitation. Without doubt, this process generated a selection bias for the two study groups, but anyone familiar with the rehabilitation process is aware that this decision algorithm is inevitable. In light of this, we believe it appropriate to qualify our results and to generalize them only to rehabilitation frameworks that use selection criteria similar to those used in this study.

There is no assurance that the use of other selection criteria would lead to identical results.

The second methodological issue is the evaluation of the success of rehabilitation at the time of discharge from the hospital rather than at a later date. Assessment of the outcome at later intervals would provide very interesting additional information. However, at the advanced age of the participating patients, to continue to isolate the variable of successful outcome from among the multitude of variables that affect their functional state would be very difficult.

Another methodological issue that should be addressed is the comparison method between the study groups. In the present study, comparisons were based on univariate analyses only, which do not control for the effect of potential confounding or interacting variables. However, given the absence of significant differences in the univariate analysis among most of the variables that were compared in the study, we feel that in this case, multivariate analyses would be superfluous.

The three underlying conditions—prior stroke, diabetes mellitus, and hyperlipidemia, for which a significant difference was found between the groups—were more prevalent in the younger group. We believe that this finding reflects a natural selection process in which patients with these conditions have a lower chance to survive so long.

No higher complication or mortality rates were found during rehabilitation in the 85+ group, and urinary tract infections were even more prevalent in the younger group. These results can be explained by the fact that despite their advanced age, the oldest old did not suffer from greater physical morbidity than the comparison patients. In our opinion, these results explain that no significant difference was found between the groups in length of rehabilitation. In our experience, this period is primarily affected by complications and loss of control of chronic comorbid conditions during hospitalization.

In general, the results of rehabilitation can be appraised by several parameters. One is the change in functional status between the inception of the process and its end. A second is the functional status of the patient at the end of rehabilitation. A third is the rate of return to home. Each of these parameters has advantages and disadvantages, so an accurate evaluation of the contribution of the rehabilitation process to the patient and his/her surroundings should be based on all three parameters together. In the present study, all three of these parameters, as well as the effectiveness and absolute efficacy of rehabilitation, were measured and all, without exception, revealed lower rehabilitation outcome values in the 85+ group compared to the 75 to 84 group.

Sixty percent of the oldest old group showed no significant improvement in their functional state throughout the course of rehabilitation. The significance of this finding differs, by the nature of things, from observer to observer. From the perspective of the "half-empty glass," the majority of the patients did not benefit from the rehabilitation effort. On the other hand, from the perspective of the "half-full glass," 40 percent of the patients, their families, and the community benefited significantly. In any event, those who believe that the investment of resources to rehabilitate patients under 85 years of age is justified should be convinced by the results that the investment in patients above this age limit is not much less justifiable.

CONCLUSION

We conclude that patients in the 85+ group who are carefully selected for rehabilitation following stroke are similar in most basic clinical, mental, and functional characteristics to younger elderly populations undergoing the same process. The length of rehabilitation and the rate of complications are similar in the two groups. Although the success rate for rehabilitation is lower in the oldest old, the results still appear to justify the effort invested in rehabilitation in the 85+ group, at least no less than that in the younger elderly group.

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