

Outcome of Subacute Stroke Rehabilitation

A Randomized Controlled Trial

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Background and Purpose—Organized acute stroke treatment reduces mortality, functional deficits, and the need of institutionalization after stroke. It is largely unknown whether the effects of treatment are due to early or subacute efforts. The aim of this randomized, controlled study was to test the hypothesis that rehabilitation of stroke patients in the subacute phase in a hospital rehabilitation unit is beneficial in reducing death and dependency and increasing health-related quality of life.

Methods—251 patients initially treated in the hospital were randomized to subacute rehabilitation in a hospital rehabilitation unit (n=127) or to the health services in the municipality (n=124) and were followed up for 7 months.

Results—The combined outcome of patients being dead or dependent (Barthel Index score of <75) was 23% in the hospital group and 38% in the municipality group ($P=.01$). Seven-month survival rates were 90.6% and 83.9% ($P=.11$), respectively. Dependency in activities of daily living was 12.6% in the hospital group and 25.0% in the municipality group ($P=.07$). Patients with a BI score of <50 before rehabilitation had significantly better outcome in the hospital rehabilitation unit, with fewer patients becoming dependent ($P=.005$) and patients having higher Scandinavian Stroke Scale ($P=.026$) and BI scores ($P=.005$). No significant differences in health-related quality of life were found. Many patients treated in the municipalities (30%) did not receive any organized rehabilitation in this study.

Conclusions—Subacute rehabilitation of stroke patients in a hospital-based rehabilitation unit improves outcome. Patients with moderate or severe stroke appear to benefit most. (*Stroke*. 1998;29:779-784.)

Key Words: rehabilitation ■ stroke management ■ stroke outcome

Studies of services specialized in caring for patients with acute stroke show that well-organized management reduces mortality, neurological deficits, functional disability, and long-term institutional care.¹⁻⁹ Still remaining unanswered are the questions of which components in the care of acute stroke patients are effective,¹ where and how rehabilitation of stroke patients in the subacute period should take place, and whether all stroke patients should be offered subacute coordinated multidisciplinary rehabilitation.¹⁰

It has been maintained that the patients most appropriate for subacute rehabilitation are those with moderately severe deficits,⁷ although one particular study⁹ showed that severely disabled patients with a poor prognosis had a better outcome when treated in a stroke rehabilitation unit. A subgroup analysis of an overview of stroke trials showed that stroke severity was not associated with the effectiveness of the treatment.¹

The resources available for long-term rehabilitation may be limited by an increasing number of stroke patients. Few randomized controlled studies exist that evaluate management of stroke patients after the acute treatment.^{2,7,11-13} In these studies the groups that were offered specialized subacute stroke rehabilitation had fewer deaths and better functional outcome (although not to a level of significance in each trial). One study¹³ has shown that specialist community rehabilitation after the acute

treatment is clinically as effective as hospital care. The Stroke Unit Trialists' Collaboration¹ showed that admission of stroke patients a week or more after a stroke did not eliminate the effectiveness of the stroke unit care.

It is therefore still under debate whether patients in the subacute phase should be offered rehabilitation in their local environment or in hospital-based rehabilitation units^{14,15} and which level of rehabilitation is proper for different subgroups.¹⁶ We have previously shown that treatment in an acute stroke unit with a length of stay of approximately 7 days reduces mortality¹⁷ and neurological but not functional deficits.¹⁸ We considered the length of stay in the acute stroke unit to be too short to affect functional disability.

This study was performed to assess the efficacy of a hospital-based rehabilitation program in reducing neurological impairment and functional disability and increasing health-related quality of life among patients with subacute stroke. We also wanted to determine whether severity influenced the benefit of a rehabilitation unit with a subacute rehabilitation program.

Subjects and Methods

Hospital Rehabilitation

The 18-bed rehabilitation unit is localized in the Central Hospital of Akershus in Norway, which serves a population of 291 905, of

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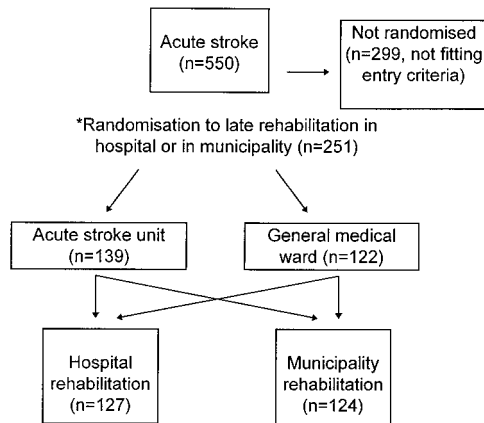


Figure 1. Diagram of patient flow. *Indicates randomization to late rehabilitation before acute treatment.

whom 49 303 are 60 years or older.¹⁹ The unit is a generalized rehabilitation unit, physically separated from the stroke unit, which rehabilitates patients with a disabling illness but is not exclusively for stroke patients. Six beds were reserved for this stroke rehabilitation study. Patients transferred to the rehabilitation unit had access to a coordinated multidisciplinary rehabilitation team of nurses; physical, occupational, and speech therapists; a social worker; and a neurologist. The staff is specially trained to treat and rehabilitate stroke patients, and they take part in education programs to improve their knowledge of stroke. In this hospital, stroke treatment is organized with initial acute treatment in an acute stroke unit or a general medical ward with a relatively short length of stay; thereafter, patients are selected to be transferred to a rehabilitation unit with a longer rehabilitation period (Fig 1).¹⁸

Stroke patients were assessed on arrival by members of the multidisciplinary team to identify problems affecting activities of daily living, speech problems, and disturbances affecting their living at home. Spouses participated routinely in meetings. Long- and short-term goals were planned, and each patient had one therapist coordinating the rehabilitation. The Bobath technique²⁰ was considered the most appropriate, and the staff was instructed in this technique, which was the main approach for physical and functional rehabilitation.

Rehabilitation in Municipalities

The catchment area of the hospital consists of 20 municipalities with populations ranging from 3000 to approximately 50 000. The local authorities are responsible for primary health care, which includes rehabilitation of disabled patients. Most municipalities have a nursing home that provides rehabilitation through a multidisciplinary staff. In one region of the County of Akershus, stroke patients had access to very specialized rehabilitation services within a rehabilitation center. The rehabilitation services offered to stroke patients consisted of nursing home rehabilitation, on either an inpatient or day-patient basis, and further ambulatory rehabilitation by a visiting physical therapist, speech therapist, and/or nurse (Table 2). Municipalities are instructed by legislation and regulations to offer access to primary health care, including physical therapy, occupational therapy, speech therapy, and nurse support. Most municipalities comply with these directions, but some have difficulties with limited capacity. There was thorough communication between the hospital and the primary health care provider before transfer of the patient to the community. For stroke patients with speech disorders, the speech therapist in the hospital obtained information about follow-up in the community.

Allocation of Stroke Patients

The inclusion and randomization procedures took place within the first day after admission to the hospital. The study was limited to acute stroke patients 60 years of age or older, with a Scandinavian

Stroke Scale (SSS) score between 12 and 52, who were conscious on admission, and patients who could cooperate in the rehabilitation program (ie, those who scored at least 4 points on the subject orientation section of the SSS). The first assessment was performed by the practitioner on duty; hence, inclusion to the trial could not be biased by the investigators. Two prognostic groups were calculated (Barthel Index [BI]) scores of <50 and ≥ 50) on the basis of the BI score recorded on day 1 after stroke. Patients with recurrent strokes and with malignant diseases not in the terminal stages were also included. Stroke victims who were comatose or somnolent on admission were not included in this study, even if they showed improvement in consciousness during the first few days after hospitalization. Patients admitted from nursing homes were not included. The patient or a relative gave informed consent. None of the patients refused to participate. Patients were given a random number, and twice weekly a person (E.L.) not involved in the treatment or investigation drew numbers for allocation of eligible patients to the rehabilitation unit or to community-based rehabilitation. If the hospital rehabilitation unit was full, patients who were selected for hospital rehabilitation were instead offered rehabilitation in the municipality (n=13). These patients, as all other patients in this study, were not excluded but were analyzed on an intention-to-treat basis. Subjects were recruited from 550 patients aged ≥ 60 years who had been admitted to the hospital within 24 hours after an acute stroke between March 1, 1994, and December 31, 1995. Two hundred fifty-one of these patients fulfilled the inclusion criteria and were randomized to the study (Fig 1). Stroke was defined according to WHO criteria.²¹ All patients were examined with use of a CT scan. Thirty-two patients died before the end of observation, and 19 patients (12 from the municipality group) were not assessed clinically after 7 months because they were not reached or did not respond to repeated contact by telephone or mail (14), did not want to travel to a hospital (4), or had moved out of the district (1).

The primary outcome measures assessed 7 months after onset were death, need of long-term care, and number of patients disabled (BI score of <75). Secondary outcomes were neurological deficits, functional disability, and quality of life. The SSS²² and BI²³ were used to assess neurological deficits and personal activities of daily living. The Medical Outcomes Study Short Form (SF-36) physical and mental health summary scales²⁴ were used to measure health-related quality of life 7 months after stroke. Assessment at 7 months was performed by the primary investigator (O.M.R.), who was unaware of where the patients had been treated and their previous scores.

The study was approved by the Ethical Committee for Medical Research (approval S-93231) and supported by the National Association Against Heart and Vascular Diseases.

Statistical Analysis

Tests used included Student *t* tests for comparison of continuous data and the χ^2 test for comparison of categorical data. The Mann-Whitney test was performed to compare the difference in the median value of the SSS and BI scores between treatment groups. Kaplan-Meier survival curves were calculated, and the difference between curves was analyzed with the log-rank test. Intention-to-treat analysis was performed for all 251 patients.

Results

Fig 1 shows the study randomization and patient flow. Table 1 shows the demographic characteristics, prior medical history, and SSS and BI scores before rehabilitation for 127 patients randomized to hospital-based rehabilitation and 124 patients randomized to municipality-based rehabilitation. Mean length of stay in the hospital before transfer to hospital- or municipality-based rehabilitation was 9.4 days and 10.4 days, respectively. The same proportion of patients in the two groups received treatment in the stroke unit before rehabilitation. Distributions of type and severity of strokes were

TABLE 1. Characteristics of Eligible Stroke Patients Randomized to the Study Groups

Characteristics	Hospital Rehabilitation (n=127)		Municipality Rehabilitation (n=124)		P
	n	%	n	%	
Mean age, y (SD)	75.5	6.7	76.5	6.4	.21
Women	60	47.2	60	48.4	.86
From stroke unit	70	55.1	69	55.6	.93
Length of stay in hospital before rehabilitation, d	9.4	5.7	10.4	7.0	.26
Living alone	44	34.6	51	41.1	.29
>7 years of education	25	19.7	16	12.9	.32
Prior medical history					
Stroke (%)	30	23.6	30	24.2	.94
Heart infarction	17	13.4	29	23.4	.07
Atrial fibrillation	18	14.2	20	16.1	.57
Hypertension	53	41.7	63	50.8	.20
Diabetes	19	15.0	15	12.1	.44
Malignancy	15	11.8	8	6.5	.14
Former smoker	42	33.1	43	34.7	.76
Current smoker	30	23.6	26	21.0	.80
Scandinavian Stroke Scale score (range)*					
On admission	44	(37–48)	43	(38–48)	.88
Day 1	45	(37–49)	44	(36–50)	.92
Day 5	48	(39–53)	48	(39–53)	.79
Barthel Index Score†					
Day 1	45	(30–70)	55	(30–75)	.29
Day 5	60	(40–85)	70	(35–95)	.69
Hemorrhage on CT	9	7.1	11	8.9	.60

Continuous data are expressed as mean±SD. Categorical data are expressed as number of patients with/without a given characteristic and also as percentages.

*Median value and interquartile range.

†Median value and interquartile range.

similar for both treatment groups (Table 1). Patients randomized to receive hospital-based rehabilitation stayed in the rehabilitation ward for a mean of 27.8 days. The SSS and BI scores before rehabilitation did not differ between the groups for the 19 patients who were lost to follow-up.

Table 2 shows the outcomes at 7 months. There were differences in the proportions of deaths and patient dependence between the two groups in favor of the hospital rehabilitation group. The differences were not significant. For the combined outcome of dependent or dead, there was a significantly better result in the group treated in the hospital. We performed an analysis in which we included missing

patients and assumed they were alive and dependent. The combined outcome (death or dependence) was still in favor of the hospital rehabilitation group (odds ratio, 0.53; 95% confidence interval, 0.31 to 0.93). Median SSS was 54 and median BI was 95 in both groups 7 months after stroke. Table 3 shows the outcome for the subgroups of patients with moderate or severe stroke (BI <50) and those with mild stroke (BI ≥50). The table shows that patients with moderate and severe stroke benefit most of rehabilitation in hospital on the outcomes dependent ($P=.005$), dependent or dead ($P=.002$), BI ($P=.005$), and SSS ($P=.026$), whereas for patients with mild stroke there were no differences except for

TABLE 2. Outcome by Treatment Groups 7 Months After Stroke

	HR	MR	P	OR (95% CI)
Death	12/127 (9.4%)	20/124 (16.1%)	.11	0.54 (0.25–1.16)
Need of long-term care	16/127 (12.6%)	13/124 (10.5%)	.60	1.23 (0.57–2.68)
Dependent (BI <75)	16/108 (14.8%)	23 /92 (25.0%)	.07	0.52 (0.26–1.06)
Dependent or dead	28/120 (23.3%)	43/112 (38.4%)	.01	0.49 (0.28–0.86)

HR indicates hospital rehabilitation; MR, municipality-based rehabilitation. Data are expressed as number of patients and also in (%), P values, and odds ratios (ORs) with 95% confidence intervals (CIs).

TABLE 3. Outcome According to Prognostic Group

	BI Score <50			BI Score ≥50		
	HR	MR	P	HR	MR	P
Death	8/64 (13%)	11/50 (22%)	.18	4/63 (6%)	9/74 (12%)	.24
Long-term care	9/64 (14%)	12/50 (24%)	.17	7/63 (11%)	1/74 (1.5%)	.02
Dependent (BI <75)	11/52 (21%)	18/36 (50%)	.005	5/56 (9%)	5/56 (9%)	1
Dependent or dead	19/60 (32%)	29/47 (62%)	.002	9/60 (15%)	14/65 (22%)	.35
Median BI	90	73	.005*	100	100	.81*
Median SSS	52	50	.026*	56	56	.83*

HR indicates hospital rehabilitation; MR, municipality-based rehabilitation; BI, Barthel Index; and SSS, Scandinavian Stroke Scale. BI and SSS scores are median values. Data are expressed as proportion of patients and also in (%) and P values.

*By Mann-Whitney test.

the need of long-term care. Table 4 describes the self-reported health-related quality of life 7 months after stroke. Of the 115 survivors from the hospital rehabilitation group and the 104 survivors from the municipality rehabilitation group, 82 (71%) and 65 (63%), respectively, were able and willing to complete the SF-36. Table 5 shows the treatment offered to patients treated in the municipality. The proportion of patients in the municipality group who were treated as inpatients was 41%. Of the remaining 59% who were treated as outpatients, 30% reported that they did not receive any specific stroke rehabilitation. Survival curves with P values are shown in Fig 2.

Discussion

This randomized, controlled study shows a benefit of early transfer of patients with acute stroke to a specialty rehabilitation unit within a hospital compared with community-based rehabilitation. The study was restricted to patients with an initial SSS score between 12 and 52 but represented more than half of the patients with stroke admitted to hospital during the study period. Seven-month outcome showed that hospital rehabilitation in the subacute phase was effective in reducing the combined outcome of death or dependence but not in reducing the need for long-term care. Patients with a

moderate or severe stroke had a significant reduction in dependency, improvement of neurological deficits (measured by SSS), and improvement in activities of daily living (measured by BI). Municipality-based rehabilitation seemed as effective as hospital-based rehabilitation for patients with mild stroke, but a ceiling effect of the BI is apparent for this group. By dividing the chain of treatment into an acute phase and a subacute phase, we were better able to document the specific contributions of each stage of treatment. Patients were treated in either a stroke unit or a general medical ward before transfer to long-term rehabilitation. We show that there is no statistically significant difference in functional outcome related to the initial treatment before admission to the rehabilitation unit (Table 1).

Some patients suffered serious deterioration in their condition after inclusion in this study and before they could take part in the rehabilitation program; hence, they could not cooperate in the rehabilitation. These patients were evaluated as having been treated in the rehabilitation unit, although they did not receive such treatment. Some of the stroke patients improved during acute treatment in the stroke unit or general medical ward and did not want to participate in a rehabilitation program, or they were not offered such treatment because they had improved to a level at which a rehabilitation program was unnecessary. To

TABLE 4. SF-36 Scores by Treatment Group 7 Months After Stroke

	HR Group	MR Group	P
Physical functioning	49 (34)	48 (36)	NS
Role physical	47 (40)	49 (41)	NS
Bodily pain	42 (14)	42 (14)	NS
General health	52 (21)	55 (22)	NS
Vitality	48 (20)	46 (18)	NS
Social functioning	75 (30)	75 (26)	NS
Role emotional	87 (31)	84 (35)	NS
Mental health	71 (17)	69 (15)	NS
Mental health summary	70 (19)	70 (17)	NS
Physical health summary	47 (20)	48 (19)	NS
Health change	4 (0.8)	4 (0.9)	NS

HR indicates hospital rehabilitation; MR, municipality-based rehabilitation; and SF-36, Medical Outcomes Study Short Form.

Data are expressed as mean±SD; values in parentheses are SD.

TABLE 5. Treatment Offered to the Municipality-Based Rehabilitation Group after Discharge From Hospital

Treated as inpatients	51/124	41%
Days in nursing home		
1–30	23	19%
31–150	8	6%
>150	20	16%
Treated as outpatients	73/124	59%
Physical therapy, ambulatory		
<1 treatment weekly	19	15%
≥1 treatment weekly	11	9%
Not known	1	0.8%
Speech therapy only	5	4%
Not offered any treatment	37	30%

Survival

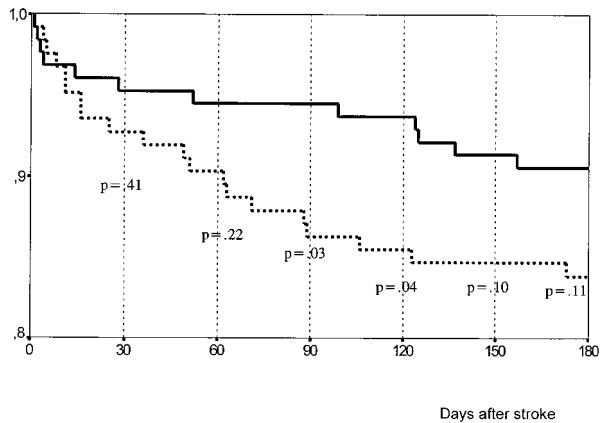


Figure 2. Graph showing survival from 0 to 180 days after stroke in patients (n=251) treated in hospital-based rehabilitation unit (solid line) and municipality-based rehabilitation (dotted line). P values are shown at 30-day periods.

avoid selection bias, these patients were not excluded but were analyzed within the group to which they were randomized. The BI and SSS assessments before patient transfer to late rehabilitation were performed without knowledge of the groups to which patients had been allocated. Patients randomized to hospital rehabilitation had lower BI scores (although not significantly so) than those randomized to the control group; however, they caught up with the municipality rehabilitation group, reaching the same median BI score after 7 months. There was no significant difference in any of the subscores of the domains of the SF-36. In contrast to other studies, this study did not show a reduction in the need of long-term care at 7 months after stroke.

Results were not due to differences in patient characteristics or in acute treatment before admission to the rehabilitation unit. The total amount of treatment offered to the hospital-based rehabilitation group seemed to exceed that offered to the control group during the 7-month period. As shown in Table 5, 41% of the municipality-based rehabilitation group were treated as inpatients, but as many as 30% did not receive any organized rehabilitation.

The results of this study come as supplementary findings to the results in our stroke unit trial, in which we showed that a stroke unit was effective in reducing death¹⁷ and hastening neurological recovery,¹⁸ and in which the difference in reduction of these deficits occurred during the acute treatment within the first 5 days after stroke.¹⁸ The effect of treatment in the rehabilitation unit on dependency is not due to survival of the patients with the best prognosis, since more patients survived in the hospital rehabilitation group, and hence probably more patients with initially severe strokes survived in this group (Table 2). The results of our trial concur with those of many stroke unit trials,¹ but both the intervention and the control groups in our study differ from those in the trials, because the acute treatment preceded rehabilitation. Our study contrasts with one evaluating early discharge from the hospital with specialist rehabilitation at home, which showed this method to be as effective as conventional treatment.¹³

Another British study did not show specific advantages of home-care services over hospital-based care.¹⁴

We do not know the reason for the difference in mortality between the two groups. Patients who stayed in the hospital had access to expert medical services 24 hours a day. Some medical complications may have been detected and treated more often and sooner among patients in the hospital rehabilitation unit. Medical adjustments were probably made more thoroughly among these patients, since it was possible to follow them daily for several weeks. The treatment offered to the control group was likely to be quite heterogeneous, because they were transferred to different municipalities with varying degrees of competence in the management of stroke patients and differences in economic and personnel resources. Although the rehabilitation of disabled stroke patients should follow guidelines for such treatment, some differences in strategies of rehabilitation may have occurred.

In our hospital the number of beds in the general rehabilitation unit is limited, thus many stroke patients do not receive rehabilitation after the acute treatment. The staff at the rehabilitation department had previously observed that patients who showed some degree of improvement during the first days after stroke often benefited most from rehabilitation. As a consequence, these patients were more frequently offered rehabilitation. It might well be that the unit selected patients for rehabilitation who already had a good prognosis of recovery, whether they received hospital rehabilitation or not. In our study it appears that the most appropriate patients for subacute hospital-based rehabilitation are those with an intermediate prognosis.

We conclude that patients with acute stroke initially treated in a stroke unit or general medical ward for a relatively short length of time benefited from treatment in a hospital-based specialist rehabilitation facility compared with treatment through a package of municipality-based services. Patients with moderate or severe stroke benefited more than those with mild stroke.

Hospital-based rehabilitation of patients with subacute stroke appears to be effective, but its efficacy could be improved by patient selection. Some of the results observed could be due to differences in the quantity of rehabilitation offered. Further research is needed to clarify the effectiveness of a hospital-based rehabilitation unit and to determine whether certain patient groups benefit more than others.

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