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USE AND COST OF ASSISTIVE TECHNOLOGY THE FIRST YEAR AFTER STROKE

A Randomized Controlled Trial

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Abstract

Objective: The objective was to compare and evaluate assistive technology given to patients treated in a stroke unit and patients treated in a general medical ward.
Method: Use and cost of assistive technology was evaluated in a randomized study comprising 249 patients during a 12-month period.
Result: Acute stroke unit care was associated with a higher prescription of assistive devices during the first 3 months. There was no difference in use and total mean cost per patient of assistive technology during the first year after stroke.
Conclusion: There was no difference in use or cost of assistive technology during the first year, but a beneficial effect was found on supplementary prescription of assistive devices during the first 3 months. The cost during the first year after stroke was a small fraction of the total costs for care and rehabilitation. It is a not expensive for the community to equip these patients and their caregivers with assistive technology, and economic resources should be available to this vulnerable group of elderly patients.

Keywords: Assistive technology, Aged, Stroke unit, Random allocation

The concept of stroke unit care has been examined in a number of randomized studies that have been published during the last decade (5;6;7;17). These studies have evaluated

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outcomes in terms of death, dependence, and institutional living. Meta-analysis has shown a clear advantage for stroke unit care, emphasizing the importance of expert teams and rehabilitation (7;17). Few studies concerning stroke rehabilitation have evaluated costs of outpatient care (2;4;14;23). The growing elderly population in the world, as well as in Sweden, has led to an increased number of elderly people suffering from stroke (21). There is little known about the use and cost of assistive technology regarding elderly stroke patients, although 85% of those who experience a stroke survive, many with lifelong disabilities (21). Since resources are limited in the healthcare sector as well as in social services, it has become more important to evaluate the economic aspect of measures in order to use the resources most effectively (9;15). Costs for inpatient and outpatient care in general, as well as effects and health-related quality of life, have been recently reported in a study on patients admitted to a stroke unit in the Göteborg 70+ Stroke Study (4;10).

Accordingly, the objective of the present study was to explore the use and cost of assistive technology in a randomized study of elderly patients with acute stroke, comparing management in acute stroke unit care continuum with conventional general medical care.

METHODS

As previously reported, the Göteborg 70+ Stroke Study is a 12-month randomized prospective controlled study of 249 patients randomly allocated to a stroke unit (SU) or to general wards (GW) at the Sahlgrenska University Hospital in Göteborg, Sweden. The designs of the study and random allocation methods have been described in detail in a recently published report (10). Of these 249 patients, 166 patients were randomized to the SU with 116 patients still alive after 12 months, and 83 patients were randomized to the GW with 57 patients still alive after 12 months. In the present study, people living in all types of accommodations, such as their own home, service apartment/house, home for the aged, and nursing home, were included. All patients are presented as survivors in SU/GW (n = 116/57), deceased (n = 44/19) or withdrawals (n = 6/7) in order to give a clear picture of use and cost of assistive technology during a 12-month period. The patients who withdrew for various reasons (10) did not seem to influence the result since none of them had extensive need of assistive technology. Most of the patients who died before the 3-month assessment had died within 3 weeks after suffering a stroke at the hospital or in a nursing home. There was no difference in mortality between the SU and the GW groups (10). Two registered occupational therapists who did not participate in the study evaluated the outcome. The patients were randomly assigned to the occupational therapists, who assessed the same patients during the entire follow-up period. Information on the use and cost of assistive technology presented in this study was collected through a structured interview questionnaire carried out at 3 and 12 months. Assistive technology was defined as assistive devices (hearing and visual devices excluded) and housing adaptations. Resource utilization in terms of inpatient and outpatient costs was recently published as part of the 70+ Stroke Study (4).

All costs were estimated at 1996 prices in Swedish crowns (SEK; exchange rate 1996: US $1 = 6.70). The costs for the assistive devices (ADs) were calculated from the costs of the devices delivered from the Technical Aids Center and included employed personnel costs and storage space costs. Costs for prescriptions, training, and follow-up were excluded since patients received assistive technology at different times, at different clinics, and within the primary healthcare sector; therefore, we believed it would be impossible to get reliable data. Real costs for the community-funded housing adaptations were received by the civic administration of the city of Göteborg. The Ethics Committee of the Faculty of Medicine, University of Göteborg, Sweden approved the study.

Statistics

The sample size of the 70+ Stroke Study was originally calculated to give the study an 80% power to show that stroke unit care resulted in 20% more patients living at home after 1 year (10). The analyses were performed according to the intention-to-treat principle (3). Differences in use were calculated with a 95% confidence interval (CI) and costs by use of a Mann-Whitney nonparametric test for continuous variables (1); $p < .05$ (two-sided) was considered significant.

RESULTS

Use of Assistive Devices

At the 3-month assessment, 76% of the survivors in the SU group and 72% in the GW group had at least one AD prescribed. Thirty-five percent of the patients assessed at 3 months in the SU group and 26% of the patients in the GW group were equipped with AD before stroke onset (not significant). These ADs were included in the analyses since they were prescribed for comorbidity and were also needed after a stroke. These devices were inexpensive and simple, and were mostly prescribed to enable walking and taking a bath or shower. There was a significant difference in prescribing ADs within the first 3 months. Eighteen percent of the patients in the SU group had received supplementary ADs, mostly simple and inexpensive devices for enabling taking a bath/shower, walking, toileting, and grip/reach devices, but wheelchairs also were prescribed. The corresponding figure for supplementary devices in the GW group was 8% ($p = .05$). Supplementary devices were prescribed for the same uses except for grip/reach, for which very few were prescribed in the GW group.

At the 12-month assessment, 82% of the survivors in the SU group and 77% in the GW group had one or more ADs (Table 1), comprising 56 different kinds of ADs. The most common AD combination was for taking a bath/shower and walking. The number of ADs per patient varied between 1–19 in the SU group and 1–18 in the GW group. The mean total amount of ADs among survivors at 12 months in the SU group was 3.7 and in the GW group, 4.0. There were no statistically significant differences in use between the groups at 12 months (95% CI, −7 to 17).

Cost of Assistive Technology

The mean costs per item for the survivors as well as for the deceased and withdrawals during 0–12 months are reported in Table 2. The total mean costs during 0–12 months for

Table 1. Percentage and Number of Patients Using at Least One Assistive Device per Item 0–12 Months After Acute Stroke

	Stroke unit group (n = 166)			General ward group (n = 83)		
Items	Survivors (n = 116) % (n)	Deceased (n = 44) % (n)	Withdrawals (n = 6) % (n)	Survivors (n = 57) % (n)	Deceased (n = 19) % (n)	Withdrawals (n = 7) % (n)
Bath/shower	66 (77)	18 (8)	0 (0)	60 (34)	21 (4)	29 (2)
Toileting	33 (38)	5 (2)	0 (0)	35 (20)	0 (0)	14 (1)
Bed/chair	18 (21)	2 (1)	0 (0)	28 (16)	11 (2)	29 (2)
Grip/reach	26 (30)	2 (1)	0 (0)	23 (13)	0 (0)	14 (1)
Walking/training	60 (70)	16 (7)	0 (0)	60 (34)	26 (5)	14 (1)
Wheelchairs/ appliances	22 (26)	16 (7)	0 (0)	25 (14)	5 (1)	0 (0)
Total	82 (95)	39 (17)	0 (0)	77 (44)	32 (6)	29 (2)

Table 2. Mean Cost per Patient (in Swedish Crowns)[a] of Assistive Devices per Patient and Item 0–12 Months After Acute Stroke

	Stroke unit group (n = 166)			General ward group (n = 83)		
Items	Survivors (n = 116) Mean cost	Deceased (n = 44) Mean cost	Withdrawals (n = 6) Mean cost	Survivors (n = 57) Mean cost	Deceased (n = 19) Mean cost	Withdrawals (n = 7) Mean cost
Bath/shower	259	59	0	308	63	85
Toileting	216	18	0	219	0	7
Bed/chair	519	215	0	1,428	51	50
Grip/reach	40	4	0	33	0	33
Walking/training	659	132	0	747	421	22
Wheelchairs/ appliances	2,635	1,268	0	2,980	389	0
Total	4,327	1,697	0	5,714	924	197

[a]SEK exchange rate in 1996 was US$1 = SEK 6.70.

the survivors in the SU group amounted to SEK 4,327 (US $646), and in the GW group the mean total costs amounted to SEK 5,714 (US $853). There were no statistically significant differences in total mean costs between the groups at 12 months ($p = .57$). The total costs per patient ranged from SEK 0 to 82,170 (US $0–12,264) in the SU group (n = 166) and from SEK 0 to 82,820 (US $0–12,361) in the GW group (n = 83) during the first year after stroke. The mean cost for housing adaptations was SEK 1,053 (US $1,571) in the SU group (n = 166) and SEK 2,068 (US $309) in the GW group (n = 83). The range was SEK 3,220–47,020 (US $481–7,018) in the SU group and SEK 11,125–68,600 (US $1,660–10,239) in the GW group. There were no significant differences in the mean costs for AD and housing adaptations between the SU and GW groups.

Use and Nonuse of Assistive Devices

Among all patients assessed at 12 months, there were no differences in use/nonuse of ADs between the SU and GW groups. Most of the ADs were used occasionally or always by the patients: 88% of the ADs in the SU group and 93% of the ADs in the GW group. However, in the SU group, 55 of 466 ADs (12%) were not used, and 17 of 261 ADs (7%), were not used in the GW group. A number of reasons were identified in the structured interview questionnaires for nonuse of devices. The reasons for nonuse in both groups were: a) the patients wanted to master the situation without ADs (22/5 for SU/GW); b) the device was not needed any longer (15/5 for SU/GW); c) the patients had deteriorated and could no longer use the device (5/2 for SU/GW); and d) the device was too complicated to use (5/1 for SU/GW).

Housing Adaptations

Eight patients in the SU group and five patients in the GW group had community-funded housing adaptations during the first year after stroke. After 12 months, 12% of the patients in the SU group and 21% of the patients in the GW group (not significant) lived in modified houses such as service apartments/houses, homes for the elderly, or nursing homes. There was no statistical difference between the SU and GW groups in the number of adaptation measures taken in the patients' own homes. All except two patients had more than one adaptation made. Several alterations were made, e.g., removal of thresholds, door opening widened, installation of ramps, showers, one hand-arm armature, handrails, and duckboards.

CONCLUSIONS

The concept of acute stroke units is well established, and the outcomes on survival and functional capacity have been documented in many studies (7). Occupational therapy is an important component in such a multidisciplinary program, including the use of assistive technology. However, there is no randomized controlled study that has examined the effect of acute stroke unit care on the use and costs of assistive technology. Accordingly, this 12-month randomized controlled study of elderly stroke patients was undertaken to address this issue. The results showed that almost a third of the patients used assistive devices prior to having the index stroke and that care in an acute stroke unit was associated with a higher prescription rate for devices during the first 3 months. After 12 months, the majority of the surviving patients had at least one AD. Data showed that the total costs for ADs were low and were lower in the SU group than in the GW group. Most of the ADs were used frequently. This agrees with several other studies of elderly persons (12;19;20;22), while another study has shown a lower usage rate (8).

Use and Costs

There were no significant differences between the SU group and the GW group in use and cost of assistive technology during the first year after index stroke. However, it was found that the total mean cost was somewhat lower for the survivors in the SU group, although a higher percentage of survivors used ADs in the SU group (Tables 1 and 2). This might indicate that the patients in the stroke unit with an early and active rehabilitation had more training in performing daily life activities with use of simpler and less expensive ADs. There was also a significant difference in prescribing supplementary assistive devices within 3 months, which indicates that the occupational therapists in the SU care continuum were more active in prescribing ADs. The cost of assistive technology was a small fraction of the total inpatient and outpatient costs for stroke care during the first year (4), and the present study showed that AD costs were 2.1% of the total costs. In another Swedish study (14), the AD costs were 1.3% of the total costs.

Our interpretation of the results is that more surviving patients in the stroke unit had ADs prescribed at a lower mean cost than patients in the general ward. This might be the effect of the stroke unit concept—as well as stroke rehabilitation in general—that training should precede the prescription of assistive devices (11). There are, however, hidden costs, because 12% and 21% of the patients in the SU and GW groups, respectively, lived in some kind of institutionalized accommodation at 12 months. These institutions provided equipment such as adjustable beds and lifts that were not individually prescribed but belonged to the institution. If these patients had lived in their own homes, the difference in costs during the first year would probably have been higher between the SU group and the GW group.

This 12-month follow-up study has indicated the importance of a continuum and evaluation of assistive technology. This has also been confirmed by other studies (8;20;24;25). In the present study, one of the reasons for nonuse of walking aids was that the patients had several different devices, because their health status and their capacity could vary depending on different weather conditions, environments, security, and accessibility. Parker and Thorslund (20) found that the most common reason for nonuse was that the patients had deteriorated or improved, which is in itself an indication of the importance of ongoing monitoring after stroke, when patients are faced with new demands after spending some time in their own environments.

Environment

In a study of patients suffering from stroke (18), it was reported that 56% of the patients who had suffered a stroke and were living in their own homes had made adjustments to

their homes after discharge from geriatric wards. This group was small and selected from geriatric rehabilitation wards; accordingly, the number of housing adaptations was higher in that group than in our study, which reported 5% of all patients (n = 249) with all levels of stroke severity (4). The striking difference compared with the study by Lofgren et al. (18) is probably due to the selection, while our study represented a cohort of elderly stroke patients. Housing adaptations in the present study were not common. This has also been confirmed in a population study of elderly people in Göteborg (12;22) and may be due to the fact that today many apartments in Sweden are already adapted with wider doorways and no thresholds. Fifteen percent of the survivors in the SU and GW groups at 12 months were living in some kind of institution that was already adapted for disabled people. In the SU/GW groups, 26 and 14 patients, respectively, were wheelchair users and 14 and 7, respectively, of these patients lived in institutions already adapted for disabled people. The patients living in their own homes often utilized the wheelchairs for outside use and managed with walking devices indoors, which might also explain the low percentage of housing adaptations in this study. Another reason for few adaptations could be that 44% of the patients in our study had a mild stroke (4).

In Sweden, assistive technology is prescribed free of charge by, among others, registered occupational therapists working in emergency clinics, geriatric wards, primary health care, and community-based rehabilitation. This is well established in Sweden and might therefore diminish differences between the SU and GW groups in this study. Accordingly, the patients in the general medical wards were well equipped with ADs, as were the patients in the stroke unit, although early prescription after stroke differed. Patients in the SU group had significantly more intervention treatment using occupational therapy and physiotherapy (10), and at the 3-month assessment significantly more patients had received supplementary ADs. However, it should be mentioned in this context that occupational therapists give intervention treatment and teach different strategies to stroke patients on how to manage the occupations of everyday life rather than just prescribing ADs to compensate for lost functions (11;16,316–320).

Elderly people may have difficulties using technology, some of them because of cognitive dysfunction or because they simply want to do without ADs and others for cultural or traditional reasons. Loss of autonomy and decreased cognitive abilities might also change the perception and use of assistive technology. A new scientific field called gerontechnology (13), which focuses on how elderly people interact with technology, provides many interesting approaches for future research. Cognitive dysfunctions, including different syndromes such as apraxia, agnosia, aphasia, and dementia, may also play an important role in the use of assistive technology, but these factors have not been delineated in the present study.

We explored the use and cost of assistive technology in a randomized study that, to the best of our knowledge, is the first study that has used a prospective design to observe a representative cohort of elderly stroke patients. We found that assistive technology was frequently used in the daily life of elderly stroke patients. Despite more frequent early prescription of ADs in the SU group, i.e., during the time of stroke unit care, the total costs during the first year after acute stroke were not higher in the SU group compared with the GW group. Thus, it is probable that prescriptions have been more in relation to the total integrated stroke rehabilitation in the acute phase. It should also be pointed out that the team's total contribution was difficult to evaluate in terms of assistive technology, because of its are advantages and disadvantages. It is advantageous if the technology can help a patient's activity performance and make it easier to live at home. However, there may be a risk that ADs are prescribed indiscriminately and with low effect on a patient's level of activity. Sometimes it is preferable to receive special training or adapt to the environment instead.

We conclude that there was a significant difference ($p = .05$) between the SU and GW groups in patients who received supplementary ADs within 3 months after stroke. The costs

were a small fraction of the total inpatient and outpatient costs for care and rehabilitation during the first year. It is not expensive for the community to equip these patients and their caregivers with assistive technology. Early adequate prescription within the context of stroke unit rehabilitation may increase possibilities for an independent life. This study shows that economic resources for assistive technology should be made available for this vulnerable group of elderly stroke patients.

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