

Stroke Unit or Medical Units in the Management of Acute Stroke: Lessons from a Controlled Trial

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The rationale of initially admitting stroke patients to medical units is to confirm the diagnosis in circumstances where all the necessary investigative techniques, skills, and equipment are available. But thereafter, is the general physician the best person to provide optimal care for the stroke patient? It can be postulated that medical units, with their emphasis on the diagnostic investigation and "cure" of disease, may not be equipped in terms of staff or facilities to handle the "care" problems inherent in the detailed planning required for the management of stroke. This was recognised by a Report from the Geriatrics Committee of the Royal College of Physicians which recommended setting up a few stroke units based on existing departments of neurology, rehabilitation, or geriatric medicine (38). This report emphasized that any scheme designed to establish stroke units must include a method of assessing their value. Several studies already have attempted to assess the effectiveness of stroke units (1,8,22,26,27,35) but a recent review of the literature concluded that the relative effectiveness of a stroke unit compared with a general medical unit in the management of stroke remains controversial (13). Accordingly, a study was set up in Edinburgh in 1974 to evaluate the effectiveness of a stroke unit compared with medical units in the management of acute stroke as an essential first step to establishing the most effective method of organising stroke rehabilitation. This chapter describes the methods used, outlines the results obtained, and summarizes the conclusions that can be drawn from the study.

METHODS

The Hypothesis

The study was designed as a randomised controlled trial to test the hypothesis that the proportion of patients who could be returned to independence after admission to a stroke unit would be higher than the proportion of patients who were admitted to medical units.

The Allocations

The traditional way of managing acute stroke in Edinburgh is by emergency hospital admission to a medical unit shortly after onset for investigation, diagnosis, and treatment. Admissions are accomplished through an Emergency Bed Bureau run by the Lothian Health Board which facilitates admission on behalf of referring general practitioners. Each medical unit has access to a full range of diagnostic facilities for investigating stroke as well as access to rehabilitation staff and facilities, either within its parent institution or in an affiliated hospital.

A stroke unit was created by changing the function of a ward of 15 beds within the Geriatric Unit at the Royal Victoria Hospital, Edinburgh. A rehabilitation team was established from existing staff already working in the hospital, under the direction of A. J. Akhtar who took no part in the assessment of outcome. No new staff were appointed specifically to the stroke unit, and particular emphasis was placed on not attempting to achieve unrealistic levels of staffing that could not be attained elsewhere. The stroke unit had been in operation for 1 year before the study commenced and had evolved an operational policy that initially was based on the work of Isaacs (21). See Akhtar et al. (2) for a full description of the clinical organization of the stroke unit.

Patients

Patients were eligible for the study from a defined population of 470,000. All general practitioners were contacted, mostly through personal visits by one of the investigators, but also by explanatory tours of the stroke unit and other stroke related meetings. Of the 277 practising doctors serving the catchment population at the beginning of the study, 275 agreed to notify appropriate patients using the definition of stroke as the onset of a focal neurological deficit of presumed vascular origin present for at least 6 hr but not longer than 3 days. There was no upper age limit, but a lower age limit of 60 was employed because the stroke unit was operating under the auspices of a geriatric unit. Practitioners were encouraged to notify all patients who appeared to be suitable. Medical staff from the study were on call 24 hr a day to undertake home visits to confirm the practitioner's diagnosis and establish clinical eligibility to participate. Only first strokes were considered for the study.

Selection Criteria

Stroke presentations seen on home visits were divided into a triage of three bands: "upper," "middle," and "lower" using selection criteria derived from previous studies of the natural history of stroke (11,23,25,37). Patients placed in the middle band of strokes using the criteria illustrated in Table 1 were eligible for the study. The upper band contained patients who were likely to do poorly whether they were rehabilitated or not. The lower band contained patients who were likely to recover spontaneously and who would not require a sustained period of rehabilitation. Concentrating on the middle band of strokes allowed a more realistic comparison

TABLE 1. *Triage used to select strokes for the stroke unit vs medical units study*

	Stroke presentation	Prognosis	Eligibility
Upper band	Unconscious at onset Already dependent in daily living activities	Bad for survival Likely to remain dependent	Excluded
Middle band	Conscious at onset Established or developing hemiplegia present	Good for survival Spontaneous recovery of independence unlikely	Included
Lower band	Conscious at onset Able to walk without human assistance	Good for survival Spontaneous recovery of independence likely	Excluded

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to be made of the relative effectiveness of a stroke unit and medical units in rehabilitating those patients whose prognosis in terms of years of life was good, but who were likely to have residual disability that would require ongoing support. Five hundred and eighty-four patients received domiciliary visits of whom 311 were placed in the middle band. All agreed to participate in the study. The mean duration of stroke in these patients from onset to the time of admission to the study was 26 hr.

Randomization

The options were allocated in a series of sealed envelopes at the beginning of the study using a system of restricted randomization and were unknown to the investigators until a patient was accepted into the trial. This was accomplished by opening the envelopes in numerical sequence during the domiciliary visit after patients' eligibility to participate had been established. Patients were then either admitted directly to the stroke unit or referred immediately to the Emergency Bed Bureau for placement in a medical unit. The management of patients during the acute phase of rehabilitation was determined by the staff of the appropriate unit; no attempt was made to restrict the clinical freedom of any medical, nursing, or therapy staff.

Outcome

The outcome of the acute phase of rehabilitation was assessed when discharge was imminent, or at a cut-off point of 16 weeks after admission. The assessment was made using a purpose-built Activities of Daily Living (ADL) unit designed to reproduce the home or other circumstances to which the patients were being discharged. The aids or adaptations that had been prescribed for patients were included in the replication of the circumstances at discharge. Patients were assessed on their

ability to perform the seven basic activities of getting in and out of bed, dressing, indoor mobility, toileting and personal hygiene, cooking a simple hot meal, feeding, and control of environment. Patients were classified as independent if they could perform all seven activities without human assistance, and dependent if they required human assistance to complete at least one activity or if they failed to carry out the activity altogether. A description of the planning and use of the ADL unit has been reported elsewhere (30).

Follow-Up

The follow-up started once patients had been discharged from hospital or at a cut-off point 16 weeks after admission and lasted for 1 year. During this period, all patients were visited at monthly intervals and an index of nursing dependency administered. This index was designed to establish the degree of assistance that patients received when performing activities of daily living during the 24 hr preceding each visit. The design, composition, and use of the index are described elsewhere (34). The functional outcome at the end of the follow-up was assessed by the same criteria and methods that were applied at hospital discharge (30). A log book was kept by all patients (or their caring friend or relative) living at home during any part of the follow-up in which all personal contacts that occurred between patients and any member of the community health or social services were recorded. Details in the log books were checked for completeness and collated on each monthly visit when the nursing dependency index was administered.

RESULTS

Outcome of the Acute Phase of Rehabilitation

One hundred and fifty-five patients were admitted to the stroke unit and 156 patients to medical units from October, 1975 to April, 1978. There were four postrandomization drop-outs, all from medical units. The mean age of the remaining 307 patients was 73 years, with an age range of 60 to 91 years. There were no differences between patients in the two allocations in age, sex, social class, marital status, home or family situation, prestroke activities, or duration of stroke present on admission to the study. The degree of hemiplegia present was remarkably similar in the two allocations on entry to the study. A difference in mean duration of hospital stay of 55 days in the stroke unit and 75 days in medical units occurred as a result of medical units having a higher residue of patients with an extended stay beyond the 16 week cut-off point. Thirty-two patients admitted to medical units were transferred during the acute phase of rehabilitation to rehabilitation or geriatric assessment units, all of which contained a varied case mix. No deaths occurred in this group. Transfers occurred at a mean interval of 33 days after admission and involved a further stay in the transfer unit of 75 days. The mean duration of stay of the 72 survivors who remained in admitting medical units throughout was 96 days.

Table 2 summarizes the outcome of the acute phase of rehabilitation. Seventy-eight (50%) of patients admitted to the stroke unit were assessed as independent compared with 49 (32%) patients admitted to medical units ($p < 0.01$, χ^2 10.49 on 2 df). When only survivors of the acute phase of rehabilitation were considered, the proportions of independent patients rose to 62% for the stroke units and 45% for medical units ($p < 0.05$, χ^2 6.46 on 1 df). The outcome of patients from medical units who were transferred for further rehabilitation and survivors who remained in their admitting medical units was the same, 47% being assessed as independent and 53% as dependent.

Investigation, Diagnosis and Drug Therapy

Similar proportions of patients in each allocation had investigations performed, supplementary diagnoses made, or drug therapy prescribed. The only medical input that revealed any statistical difference was the mean number of stroke-related investigations performed. This happened because staff in the stroke unit carried out more chest and skull X-rays and screened more patients for neurosyphilis. A very low proportion of patients received lumbar puncture, electroencephalography, brain scanning, or computer assisted tomography in either allocation.

Nursing Dependency

Nursing dependency was measured using a modified version of the Dundee chart, patients being classified into low, medium, and high levels of nursing dependency (10). All patients in the stroke unit were concentrated in the middle range of dependency whereas medical units that had a heterogeneous case mix had patients spread over all three bands of nursing dependency. Nursing activity times for tasks such as washing and toileting patients in the stroke unit were higher than times for similar activities that had been collected in a previous nursing study of medical and surgical units in Edinburgh hospitals (19).

TABLE 2 Outcome at end of acute phase of rehabilitation (figures are numbers (%) of patients)

	Stroke unit (N = 155)	Medical units (N = 152)
Independent	78 (50)	49 (32)
Dependent	47 (31)	60 (40)
Dead	30 (19)	43 (28)

Significance of difference: $p < 0.01$ ($\chi^2 = 10.49$, $df = 2$).

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Social Work

A much higher proportion of stroke unit patients required social work, but more time was spent on medical unit patients who were referred. The nature of the contacts that social workers had with patients, relatives, other members of the hospital staff, community services etc. was similar in both allocations as was the distribution of time used in these contacts.

Physiotherapy

High levels of referral for physiotherapy were achieved in both the stroke unit and medical units. As Table 3 demonstrates, there were significant differences in favour of the stroke unit in the proportion of patients receiving any physiotherapy and in having the shorter delay between admission and physiotherapy commencing. Medical unit patients using physiotherapy had a longer period of therapy and consumed a significantly greater number of hours of treatment. These latter differences were due to the longer mean duration of stay of medical unit patients, 57% of all physiotherapy consumed being used by patients who had an extended hospital stay. When these patients are excluded, the differences in therapy duration and time consumption disappear.

Important differences in the use of physiotherapy occurred among patients transferred from medical units when they were compared with those who remained in the initial admitting hospital, the mean consumption of physiotherapy among these transfer patients being more than double that of stroke unit survivors. Seventy-three percent of physiotherapy consumed by this group took place after transfer from the medical unit.

Occupational Therapy

Major differences in the use of occupational therapy between allocations occurred and are summarized in Table 4. The differences between the proportion of patients receiving any occupational therapy and particularly, the mean intervals between hospital admission and the commencement of occupational therapy were striking. Put another way, 66% of all patients had begun occupational therapy within 1 week

TABLE 3. *Use of physiotherapy**

	Stroke unit (N = 155)	Medical units (N = 152)	Significance of differences
No. (%) of patients receiving any physiotherapy	149 (96)	134 (88)	$p < 0.05$
Delay in starting treatment (days)	3.0 \pm 0.3	3.8 \pm 0.2	$p < 0.05$
Duration of treatment (days)	49.3 \pm 3.3	70.5 \pm 7.8	$p < 0.05$
No. of hrs of treatment	21.0 \pm 1.5	36.4 \pm 4.0	$p < 0.001$

*Figures are means \pm S.E.

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TABLE 4. Use of occupational therapy (Mean results expressed \pm S.E.)

	Stroke unit (N = 155)	Medical units (N = 152)	Significance of differences
No. (%) of patients receiving any occupational therapy	136 (88)	71 (47)	$p < 0.001$
Mean delay in starting treatment (days)	6.4 \pm 0.5	21.1 \pm 3.8	$p < 0.001$
Mean duration of treatment (days)	46.9 \pm 3.2	68.6 \pm 10.3	$p < 0.05$
Mean no. of hrs of treatment	33.3 \pm 2.4	48.2 \pm 6.1	$p < 0.05$

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of admission to the stroke unit compared with only 18% of all admissions to medical units in the same time period. The pattern of medical unit patients who were referred as having a longer duration and a higher overall consumption of therapy seen in physiotherapy was repeated.

The proportion of transfer patients from medical units who received occupational therapy approached the level of that obtained by survivors in the stroke unit. Transfer patients had more than double the consumption of occupational therapy compared with stroke unit patients, but no less than 89% of this occupational therapy was provided after the transfer from medical units had occurred.

Speech Therapy

There were no dramatic differences in the use of speech therapy between allocations to match those seen in the use of occupational therapy. Only 13% of stroke unit and 18% of medical unit patients received any speech therapy. The mean delay to commencement, mean duration and mean amount of time used was 9 days, 61 days, and 17 hr respectively for patients in the stroke unit, and 6 days, 65 days, and 11 hr respectively for patients in medical units.

Aids and Adaptations

Prescribing aids to daily living and providing adaptations to patients' home environment may have an important bearing on the outcome of stroke rehabilitation. Table 5 summarizes the provision of aids and adaptations to the survivors of the acute phase of rehabilitation and highlights the significant differences between the stroke unit and medical units in this respect. Patients may derive no benefit from special aids and adaptation if their "accessory" aids such as spectacles, hearing aids, and dentures are not in working order. There was a striking difference in the proportions of patients in the two allocations who had their accessory aids modified or replaced during the acute phase of rehabilitation.

Communication

Family members of stroke patients are an important resource that should be used by hospital staff. To make full use of this resource requires the active involvement

TABLE 5. Use of aids and adaptations

	Stroke unit		Medical units		Significance of differences
	No.	%	No.	%	
Aid(s) and/or adaptation(s) prescribed during hospital stay	103	82	61	56	$p < 0.001$
Accessory "aids" modified or replaced by hospital staff*	68	54	12	11	$p < 0.001$

*Spectacles, hearing aids, and dentures.

of all members of the hospital rehabilitation team in reassuring, discussing the prognosis, and describing the plan of treatment to key family members. There were significant differences between the allocations in the proportion of caring persons who reported that they had contact with members of the hospital staff, particularly medical consultants and therapists. These differences were much less pronounced when the contacts were separated into those initiated by the caring person themselves and those in which the hospital staff made the initial approach.

Completing the Triage of Stroke Rehabilitation

All study patients placed in the upper and lower bands were followed up and their outcome noted at the time of hospital discharge. It was also necessary to look for all cases of stroke that were not referred to or accepted by the study in order to complete the triage. It was particularly important to identify middle band strokes who were admitted to hospital directly by their G.P.s or through an accident and emergency department. The identification of all cases of stroke was limited to those admitted to hospital during the years 1976 to 1977, although the intake period of the trial extended from October 5, 1975 to April 30, 1978. All stroke admissions among patients age 60 and over from the defined population during 1976 to 1977 were identified from case listings of Scottish Hospital Inpatient Statistics. A one-in-three random sample was drawn and the medical records of these patients examined to determine where they would have been placed in the triage and to ascertain their outcome on hospital discharge. This was undertaken using the Rankin Disability Scale, a more subjective assessment of stroke dependency that has been widely used in other studies based on reviews of medical records, but which was compatible with the Activities of Daily Living classification used in the trial (29). Seventeen medical records could not be traced. It was not possible to establish the position in the triage of stroke patients from the defined population who were retained at home throughout by general practitioners.

INCIDENCE OF STROKE

The total number of strokes among persons age 60 and over in the defined population who were admitted to hospital in 1976 to 1977 was 1,429. Upper band

strokes accounted for 43% of all strokes, middle band strokes 24%, and lower band strokes 33%. Seventy-one percent of all middle band strokes were referred to the study compared with 18% of upper and 23% of lower band strokes.

The average annual age- and sex-specific incidence rate for hospital admission of stroke was 7.3 per 1,000 persons age 60 and over. This rate comprised 3.1, 1.8, and 2.4 per 1,000 person-years for upper, middle, and lower band strokes respectively.

THE SIZE OF A STROKE UNIT

Basing the study on hospital admissions from a defined population and completing the triage of stroke rehabilitation for all such admission enabled an estimate to be made of the number of beds that would be required for a stroke unit per unit of population. The steps taken in estimating the size of a stroke unit required to admit acute strokes in the middle band is presented in Table 6. This estimate is made assuming the same criteria for placement in the middle band of stroke, that all middle band strokes occurring in the defined population are referred to hospital, the same case fatality ratio is present, the same mean duration of stay that applied to the stroke unit in the study occurs, and the bed occupancy rate is that which applied to medical units in Scotland during 1976 to 1977 (20). If these assumptions are applied, the number of beds required for a stroke unit in a standard population would be four beds for every 10,000 persons age 60 and over, or 15 beds for a stroke unit located in a district general hospital serving a population of 250,000, 18% of whom were age 60 or over.

OUTCOME OF THE CONTINUING PHASE OF REHABILITATION

Eighteen patients from the stroke unit and 12 from medical units died during the follow-up period of 1 year. Six patients in each group were lost to follow-up, leaving 101 patients from the stroke unit and 91 patients from medical units whose outcome was reassessed 1 year later. The initial improvement in outcome brought

TABLE 6. *Size of a stroke unit*

Average annual incidence rate of middle band stroke in persons ages ≥ 60 . 1.8 per 1,000 person-years*
Assuming the mean hospital stay in the stroke unit = 55 days
Assuming the bed occupancy ratio . 0.85 ^b
Number of beds required for a stroke unit to serve a population of 10,000 persons aged ≥ 60
$= \frac{55 \times 1.8 \times 10}{7 \times 52 \times 0.85} = 4 \text{ beds}^c$

*Age and sex adjusted to the Scottish population ages 60 and over at the 1971 census.

^bBased on bed occupancy of medical units in Scotland, 1976.

^cRounded to the nearest whole number.

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about by the stroke unit as shown by the increased proportion of patients assessed as independent at discharge had disappeared by 1 year, with 56 patients (55%) from the stroke unit being reassessed as independent compared with 52 (57%) of the patients discharged from medical units. Thirteen of 67 previously independent patients from the stroke unit (19%) became dependent. On the other hand, 11 of 45 previously dependent patients from medical units (24%) were classified as independent.

We identified two factors that may have contributed to these changes. Over 80% of all surviving patients lived in their own homes at any point during the follow-up, the overwhelming majority living with relatives or friends. We compared the activities of daily living these patients were actually performing with those they were capable of performing. Human assistance was provided for all patients living at home who were dependent when discharged from hospital. There were appreciable differences, however, between the proportions of independent patients who had been treated in the stroke unit and those treated in medical units who received help when performing activities of daily living. At the beginning of the follow-up, 58 (58%) of the patients discharged from the stroke unit and 34 (37%) of those discharged from medical units received assistance for at least one activity in which they had been assessed as independent at hospital discharge. When dependent patients were examined, a higher proportion from medical units were carrying out activities unaided as the follow-up progressed compared with patients from the stroke unit. Thus, independent patients from the stroke unit were allowed to do less during the follow-up than independent patients from medical units, and dependent patients from medical units were allowed to do more than similar patients from the stroke unit.

The second factor was the early discharge of patients from medical units. Mean duration of hospital stay was 47 days for patients judged at discharge from medical units to be dependent who were reassessed as independent at the end of follow-up compared with 91 days for patients from medical units whose outcome did not change. Hence the patients from medical units whose functional outcome changed to independent during the follow-up received less physiotherapy (a mean of 26 hr over 34 days) than the other patients discharged from these units (a mean of 42 hr over 89 days). A similar trend occurred in the use of occupational therapy (a mean of 40 hr over 31 days compared with 51 hr over 78 days). These trends did not apply to patients treated in the stroke unit.

USE OF COMMUNITY SERVICES DURING THE CONTINUING PHASE OF REHABILITATION

The use of community-based health and social services by patients located at home during any part of the follow-up is summarized in Table 7. The proportions of patients who used services were similar in both allocations with the exception of health visitor involvement, where there was a significant difference in favour of the stroke unit. The general practitioner was seen by the highest proportion of

TABLE 7. *Continuing phase of rehabilitation: The use of community services*

Service	Stroke unit (N = 112)			Medical units (N = 93)			Significance of differences
	No.	%	Number of contacts mean \pm S.E.	No.	%	Number of contacts mean \pm S.E.	
General practitioner	99	88	9.4 \pm 0.7	81	87	9.2 \pm 0.7	NS
Health visitor	85	76	4.0 \pm 0.4	32	34	3.1 \pm 0.7	$p < 0.001$
Community nurse	61	54	20.7 \pm 2.6	37	40	23.1 \pm 3.8	NS
Social worker	11	10	2.3 \pm 0.5	13	14	2.5 \pm 0.8	NS
Home help	41	37	111.1 \pm 9.9	29	31	98.3 \pm 12.7	NS
Chiropodist	46	41	3.8 \pm 0.3	30	32	2.8 \pm 0.3	NS
Meals on wheels	2	2	59.0 \pm 9.0	6	7	61.2 \pm 13.2	NS
Voluntary agencies	9	8	33.7 \pm 11.4	14	15	20.5 \pm 11.9	NS

Significance of differences is between percentages of patients receiving each service: NS = not significant ($p > 0.05$).

The mean (\pm S.E.) number of contacts refers only to those patients who received any contact with the relevant community service.

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TABLE 8. *Continuing phase of rehabilitation: The use of hospital services*

Service	Stroke unit (N = 112)			Medical units (N = 93)			Significance of differences
	No.	%	Number of contacts mean \pm S.E.	No.	%	Number of contacts mean \pm S.E.	
Hospital out-patient clinic attendance	75	67	9.0 \pm 2.6	49	53	13.6 \pm 4.1	NS
Day hospital attendance	27	24	38.2 \pm 6.4	9	10	36.9 \pm 13.9	$p < 0.05$
Physiotherapist	85	76	34.4 \pm 3.1	45	48	34.2 \pm 6.7	$p < 0.001$
Occupational therapist	59	53	20.7 \pm 3.8	40	43	14.6 \pm 3.2	NS
Speech therapist	14	13	32.1 \pm 5.9	13	14	20.3 \pm 6.5	NS

Significance of differences is between percentages of patients receiving each service: NS = not significant ($p > 0.05$).

The mean (\pm S.E.) number of contacts refers only to those patients who received any contact with the relevant hospital service.

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patients in both allocations, but did not have the highest frequency of contact. This was provided by the home help service, which averaged two contacts per week among one-third of patients from each allocation.

USE OF HOSPITAL SERVICES DURING THE CONTINUING PHASE OF REHABILITATION

Significant differences occurred in the proportions of stroke unit and medical unit patients who received any out-patient physiotherapy or attended a day hospital (Table 8). Further differences in the proportion of patients who attended hospital out-patient clinics and received out-patient occupational therapy occurred, but the

differences did not reach conventional levels of statistical significance. The proportion of patients receiving out-patient speech therapy was similar to the proportion who received it as hospital in-patients during the acute phase of rehabilitation. During follow-up, there was no repetition of the imbalance that had occurred between the allocations in the mean amount of physiotherapy and occupational therapy used during the acute phase of rehabilitation by the group of patients with an extended hospital stay.

Functional Outcome and Services Used

The use of services was examined in relation to the functional performance of patients at the time of hospital discharge. The level of use of community-based services was not related to outcome expressed as independence or dependence in performing activities of daily living. There were three statistically significant differences in the proportion of independent versus dependent patients who received services, but none when the mean number of contacts for different community services was considered. Community nursing was the only service where both the coverage and frequency of contacts were higher in dependent patients. Surprisingly, this did not apply to the home help service. A higher proportion of independent rather than dependent patients received contact with the general practitioner and health visitor. There was evidence that the use of hospital services was related to patients' functional performance. With one exception (attendance at medical out-patient clinics), a higher proportion of dependent patients received hospital services than independent patients. This trend also applied to the mean number of contacts which stroke unit patients received, dependent patients having more contacts than independent patients for all hospital services.

DISCUSSION

Establishing a special unit improved the natural history of stroke by increasing the proportion of patients who were returned to functional independence. The difference in outcome is statistically significant, and may be clinically important in the context of the future organisation of services for the care and rehabilitation of acute stroke.

Utilization of Therapy

Differences in the utilization of therapy were found that could have contributed to the improved outcome of patients admitted to the stroke unit. It is not possible to say whether the optimum level or mix of therapy was used to achieve the improvement in functional prognosis. This information can only come from a series of trials that examine the impact of different levels of each component of stroke rehabilitation in turn while maintaining the input of all other components constant.

Admission to the stroke unit did not result in the intensive use of therapy that might have been implied by the creation of such a unit. What was achieved in the

stroke unit was almost universal coverage of physiotherapy and occupational therapy and shorter delays before commencing treatment. The mean use of 21 hr of physiotherapy and 33 hr of occupational therapy for each referred patient in the stroke unit is quite modest. It was also significantly less than the mean consumption of occupational therapy and particularly physiotherapy among referred patients in medical units. The low level of speech therapy involvement is not surprising, being similar to the level reported to be used in stroke rehabilitation by other workers and in line with the prevalence of dysphasia found in stroke (5,7). The policy of transferring a selected group of patients from medical units after a number of weeks have passed and then subjecting them to intensive therapy must be seriously questioned. The failure to improve the functional outcome of this group of transfer patients compared with survivors who remained in admitting medical units throughout is further evidence that wider coverage of stroke patients with rehabilitation potential accompanied by earlier intervention might be a more effective answer to the problem than a late, concentrated effort (16). Other important questions that need to be answered are which patients will benefit from continued therapy over a long period of time? Is the present policy of treating most patients for the total length of their hospital stay making the best use of scarce resources, or should attention be focused on early referral of selected patients for more coordinated treatment by therapists and nursing staff? In some cases, consideration might usefully be given to greater involvement of relatives in maintenance therapy, provided that therapists are readily available to give advice and check progress.

Triage System Criteria

A group of patients were identified as those likely to derive the most benefit from intervention in the provision of rehabilitation services after acute stroke. The development of a system of triage that defined a middle band of stroke was probably an important factor in being able to accept the hypothesis that a stroke unit could return a higher proportion of patients to independence after onset of acute stroke than could medical units. Comparing the outcome of middle band strokes with upper and lower band strokes at the time of hospital discharge indicated that the criteria used in the triage were broadly correct. Further development of the triage is required in order to reduce or eliminate the inconsistencies that resulted in the outcome of 5% of upper band strokes being independent and 15% of lower band strokes not surviving or remaining dependent. This might be achieved by refining the selection criteria used, and there is an urgent need to develop ways of predicting functional outcome following stroke that would be clinically useful in selecting those patients who are most likely to benefit from management in a stroke unit (17). An attempt to develop a standard neurological examination that could be useful in this context was made in this study and has been reported elsewhere (28). The experience of this group of investigators in attempting to reduce the considerable observer variation present in using this standard neurological examination has also been described (15).

Alternatively, the efficiency of the triage might be improved by altering the timing at which it has applied. The triage was applied in the study at a mean period of 26 hr after stroke onset in order to satisfy the requirements of general practitioners and hospital staff who participated in the study. A delay of 3 or 4 days would probably have eliminated or greatly reduced the inefficiency of the triage process because more strokes would have stabilised and certain patients proved their ability to survive. This also would be a better time to select patients for admission to a stroke unit because it is unlikely that a domiciliary service similar to that used to admit patients to the study could be contemplated in routine clinical practice. It also would enable the present desirable policy of admitting acute strokes to medical units in order to confirm the diagnosis and initiate relevant treatment for concomitant conditions to continue. Completing the triage of stroke rehabilitation for all hospital admissions from the defined population enabled an estimate to be made of the number of beds required for a stroke unit to serve a standard population. What is striking is the comparatively low incidence of middle band strokes in this population which, if confirmed by studies conducted on other defined populations, would suggest that only one-fourth of strokes, at least among persons ages 60 years and over, might be suitable for admission to a stroke unit. Thus, it may be possible to consider stroke units as a realistic policy in the National Health Service in the same way that it has been suggested recently that intensive out-patient rehabilitation may be feasible for the small proportion of stroke patients who would benefit from it (32).

Follow-Up Results

The results of the follow-up are both surprising and disappointing. They emphasize the importance of follow-up of patients over a sufficiently long period to be certain that improvements in the natural history of a disease produced by interventions in the working of health services do not disappear when the intervention is withdrawn. Thus, while intervention in the management of stroke at an early stage after onset through the establishment of a stroke unit created a temporary improvement in the natural history of the disease, it did not provide a sustained or long-term advantage over more conventional management in medical units. The data do not provide conclusive reasons why this should have occurred. A larger number of patients assessed as independent at discharge from the stroke unit subsequently regressed to functional dependence compared with patients discharged from medical units. This may have occurred as a result of the greater protection given by the caring relatives and friends who provided more assistance than necessary and thereby did not permit patients from the stroke unit to carry out activities of daily living of which they were capable. Relatives and friends of patients who had been in the stroke unit may have had a heightened awareness of the patients' disabilities as a result of the better communication that existed with members of the staff of the stroke unit. Thus the opportunity was available to give adequate orientation and instruction to the families of patients in the stroke unit about the

need to maintain gains made during the acute phase of rehabilitation. But the extent to which this opportunity was taken and the reasons why families might have adopted a more protective role to the detriment of the long-term functional outcome of these patients are not known.

The other factor that contributed to the final outcome was the larger number of patients from medical units who were dependent at hospital discharge but who gained their independence during the follow-up. This group stayed in hospital for a much shorter period than other patients in the medical units. Consequently they received less physiotherapy and occupational therapy and their full rehabilitation potential may not have been realized when they were discharged from hospital. Pressure on medical-unit beds created predominantly by patients with strokes has been recognised as a problem (33) but the extent to which this was responsible for early discharge from the medical units of patients whose rehabilitation potential might not have been fully realized is not known. The results of the follow-up confirm that management of stroke continues well beyond the acute phase in hospital and further suggest that if the input of only one factor in the chain of stroke rehabilitation is inappropriate, incomplete, or missing, the contribution of all other factors may not lead to the successful long-term maintenance of patients with stroke returned to independence in the community.

Use of Health and Social Services

No clear conclusions can be drawn about the use of health and social services in the long-term management of stroke patients. A higher proportion of stroke unit patients living at home compared with medical unit patients at home used services during the follow-up. This applied to virtually every individual hospital and community service, although many differences were not statistically significant. There is no information available to explain why the consistent pattern of higher use of services by stroke unit patients occurred, although better levels of communication with general practitioner and community services, combined with the higher level of hospital follow-up arranged prior to hospital discharge must have been contributory factors (14). Yet, it was a higher number of patients from medical units whose functional performance improved following hospital discharge while more stroke unit patients regressed to become dependent in daily living activities. The overall levels of contact with virtually all services were low and confirm the findings of previous reports that the involvement of health and social services in the long-term management of stroke patients is not very extensive (4,36). By far the most frequent contribution was made by the home help service, and particular attention should be paid in the future to assessing the role of home help in the long-term management of stroke.

Interpreting the Results

The planning, conduct, and interpretation of the results of this study are subject to some of the limitations that apply to controlled trials in health care (18). Even

though the study was undertaken in a defined population, it cannot be assumed that the findings of the study would be useful in other areas. Different geographical areas may have different local priorities that could render the clinical importance of being able to accept the hypothesis that was tested less relevant to a local situation. For example, the fact that the short term improvement in functional outcome among stroke unit patients was achieved by using more occupational therapy may rule out the possibility of establishing a stroke unit if there were no occupational therapists available in the area concerned.

The inferences that can be drawn from the study and applied to patients in other locations are also restricted because many other factors relating to the management of acute stroke that were involved in this study must be taken into consideration. The pattern of hospital care for stroke in the defined population was similar to Scotland as a whole except that a higher proportion of admissions were placed in medical units. This does not exclude the possibility that hospital admission and discharge policies for stroke patients that could influence outcome might be different in other centers. Longer delays between onset and hospital admission might occur, or patients could be discharged early before their full rehabilitation potential had been realised. The policy of who, where, when, and how to provide treatment for acute stroke in hospital might also differ in other locations. Additional factors other than hospital admission, treatment, and discharge policies might affect the outcome of stroke rehabilitation. For example, knowledge, opinions, and attitudes towards stroke among members of hospital staff and patients' families may not be similar in other centers. Thus, just because the study has demonstrated that a stroke unit can return a higher proportion of patients to functional independence at the end of the acute phase of rehabilitation does not mean that this would occur wherever stroke units are set up. This study can only point the way to the need for further evaluation at other centres, and if similar findings are made elsewhere, wider inferences may be justified.

Double blind procedures when neither patient nor doctor know which treatment is being given are widely used in therapeutic trials in order to avoid the possibility of bias. Blindness could not be introduced into the design of this study because it involved the use of different facilities as the alternative forms of health care being compared. One major source of bias that might have arisen in the study (as a result of being unable to implement blindness) could have been a change in the performance of medical units as a result of heightened awareness of participating in the study over time. A careful search of the data was made for supporting evidence that this might have occurred, but none was found. The fact that several medical units were involved and that each contained other stroke patients who were not participating in the study might have helped to avoid the potentially serious bias that could have arisen as the study progressed. Lack of blindness also limited the methods of data collection that could be employed: in particular, direct observation of events that occurred during the acute phase of rehabilitation could not be considered, as this would have been accompanied by the risk of influencing treatment through a heightened awareness of the study. A consequence of being unable to

make direct observations because of the lack of blindness was the absence of information on four important aspects of the acute phase of stroke rehabilitation.

1. *Methods of rehabilitation employed in the stroke and medical units.* While the study has provided information on the timing, duration, and amount of therapy used by patients in the stroke and medical units, it was not possible to obtain any information about the actual methods of rehabilitation used. In particular, no data is available to indicate whether active or remedial therapy was employed, to what extent an individual or group approach to therapy was used, or which of the techniques of Brunstrom (6), Bobath (3), or Knott (24) formed the basis for physiotherapy treatment in either allocation.

2. *The stroke unit as a therapeutic community.* An important contribution to the difference in outcome between the stroke and medical units might have been the psychological and therapeutic effect that the stroke unit had on patients. The stroke unit can be envisaged as a community where the close relationship between the hospital staff and patients played an important part in achieving a higher level of functional independence in its patients than occurred in medical units which offered a more conventional institutional approach. The study has provided no insight into this important aspect of stroke rehabilitation.

3. *Input of different members of the rehabilitation team.* A major advantage that has been put forward for setting up stroke units is the opportunity to develop a collaborative policy for stroke rehabilitation (21). This should form the basis for constant and active teamwork between the different members of the rehabilitation team (12). While the study was able to obtain information on the use of several of the components that are advocated for the rehabilitation of acute stroke such as diagnostic investigations, drug therapy, social work involvement, nursing dependency, aids and adaptations prescribed, as well as the use of physiotherapy, occupational therapy and speech therapy, no data could be obtained on the relationship between the contribution of these various components. For example, to what extent were the longer nursing activity times in the stroke unit due to nursing staff providing additional physiotherapy, or occupational therapy to patients when the trained therapy staff had gone off duty? Answering questions of this nature would have required the kind of direct observations that could not be considered in this study.

4. *Difference in mortality between the stroke and medical units.* The difference in mortality between the stroke unit (19%) and medical units (28%) cannot be explained satisfactorily. Confirmation of previous reports (9) that this difference might have occurred as a result of the stroke unit reducing the number of secondary complications due to stroke would again have required the kind of direct observation likely to encourage treatment bias in the absence of blindness.

CONCLUSION

The hypothesis that a stroke unit could discharge a higher proportion of patients following acute stroke who were independent in daily living activities compared with the proportion of such patients who were discharged from medical units can

be accepted. Differences in the use of some of the components of rehabilitation including almost universal coverage of physiotherapy and occupational therapy and shorter delays before commencing treatment could have contributed to the improved outcome of patients admitted to the stroke unit. However, the improvement in outcome amongst stroke unit patients at the time of hospital discharge had disappeared by the end of 1 year. Factors that may have contributed to this final result are overprotection by the families of patients who were not permitted to carry out activities of daily living in which they were independent, and the early discharge from medical units of patients whose full rehabilitation potential had not been realised. Thus, while intervention in the management of stroke at an early stage after onset through the establishment of a stroke unit created a temporary improvement in the natural history of the disease, it did not provide a sustained or long-term advantage over more conventional management.

Stroke rehabilitation is a continuing process and prolonging the benefits of short term gains made in functional outcome through the intervention of a stroke unit requires that all the links in the chain of rehabilitation are maintained including the proper orientation of patients' families before home discharge is arranged. Appropriate levels of support from community health and social services based on criteria of need are required to support families who are carrying the burden of stroke dependency in the community. Completing the triage of stroke rehabilitation has enabled the size of a stroke unit per unit of population to be calculated, and this should form a useful baseline for establishing stroke units once all the links in the chain of stroke rehabilitation have been completed. Because of the limitations inherent in carrying out controlled trials in health care, the inferences that have been drawn from this study must be widened by attempting to replicate the findings in other centers before any policy to establish stroke units for the management of acute stroke can be adopted universally.

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