

L.C. Juby^a
N.B. Lincoln^a
P. Berman^b
for the Stroke Unit Evaluation
Study Group

^a Stroke Research Unit and

^b Department of Health Care of the Elderly,
City Hospital, Nottingham, UK

The Effect of a Stroke Rehabilitation Unit on Functional and Psychological Outcome: A Randomised Controlled Trial

Key Words

Stroke outcome
Stroke rehabilitation
Activities of daily living
Psychological outcome
Stroke unit

Abstract

The outcome of patients receiving rehabilitation on a stroke unit (SU) was compared with that of patients on general medical and health care of the elderly wards (conventional wards; CWs) in a randomised control trial. Of the 315 stroke patients admitted to hospital, 176 were randomly allocated to the SU and 139 to CWs. Outcome was assessed on the Barthel Index, Rivermead Activities of Daily Living Scale (ADL), Nottingham Extended ADL scale, General Health Questionnaire, Mood Ratings and Adjustment scales at 3, 6, and 12 months after stroke by an assessor who was 'blind' to their group allocation. SU patients spent significantly longer in hospital. There was a significant difference in personal ADL at 3 and 6 but not 12 months after randomisation. On measures of extended ADL, SU patients were significantly more independent at 6 and 12 months but not at 3 months after randomisation. There were no significant differences between the groups in mood at 3 and 6 months, but SU patients showed better mood 12 months after randomisation. There was a significant difference in adjustment 6 months after randomisation. Patients who received rehabilitation on SUs were more independent in activities of daily living compared with those who received rehabilitation on CWs. By 6 months they were also psychologically more able to cope.

Introduction

Most patients with stroke are admitted to hospital [1]. However, hospital management has been fragmented and standards of assessment, rehabilitation and follow-up highly variable [2]. In an attempt to develop more cohesive and organised services, stroke units (SUs) have been

established. These vary in their mode of operation, some taking patients when first admitted to hospital and others providing non-acute rehabilitation services.

Although some have been limited by lack of 'blind' outcome assessment, previous randomised trials have reported that care in both acute SUs [3, 4] and non-acute stroke rehabilitation units [5] improves early functional ability without increasing therapy time or prolonging hospital stay. Garraway et al. [6] found that improved ability in a range of self-care tasks at discharge had disappeared by 1 year. Indredavik et al. [4] reported that significant

The Stroke Unit Evaluation study group consists of the authors and Dr. A. Drummond, Dr. N. Miller, Mr. M. Colquhoun, Ms. P. Clarke.

KARGER

E-Mail karger@karger.ch
Fax +41 61 306 12 34

© 1996 S. Karger AG, Basel
1015-9770/96/0062-0106\$10.00/0

Dr. N.B. Lincoln
Stroke Research Unit
Nottingham City Hospital NHS Trust
Hucknall Road
Nottingham NG5 1PB (UK)

Received:
October 18, 1994
Accepted:
July 24, 1995

differences in functional abilities using the Barthel Index were maintained 1 year after stroke. Kalra et al. [5] did not report the results of follow-up after hospital discharge.

Independence in activities of daily living is not the only desirable outcome of SU care. Psychological adjustment to disability is a significant problem following stroke [7, 8] but has not been adequately investigated in previous SU trials. Kalra et al. [5] suggested that part of the benefit of an SU was the emotional support provided but psychological outcomes were not formally assessed.

SU care can also influence survival. A statistical overview of randomised, controlled trials of specialist SU care has indicated sustained reduction in mortality of 28% [9].

The SU in Nottingham is a 15-bed rehabilitation unit located in one of two teaching hospitals, serving a combined population of approximately 650,000. It is well established, having been in operation since 1982. Detailed multi-disciplinary assessment and ward-based rehabilitation are combined with careful and co-ordinated discharge procedures. Attention to detail, the achievement of full potential in therapy and close involvement of carers are considered important. Early access visits to assess the home, home visits with the patient and overnight stays at home, are linked to coordinated input from a liaison nurse and social services to achieve satisfactory discharge and follow-up. Patients and relatives are encouraged to join support groups and most patients continue rehabilitation after discharge.

The aim was to conduct a randomised controlled trial of the effectiveness of this stroke rehabilitation unit. 'Blind' assessment on outcome measures and long-term outcome were considered important. In addition to establishing whether SU care enabled more stroke patients to reach greater independence than conventional wards (CWs), the aim was to determine whether more patients were able to adjust better to residual disability than those managed in conventional settings.

Subjects and Methods

All patients admitted to Nottingham hospitals with first or recurrent stroke between 1 January 1991 and 30 June 1993 were recorded on a register and were considered for inclusion in the study unless:

- (a) they had a home address outside Nottingham District Health Authority or adjacent districts,
- (b) they were unconscious on admission to hospital,
- (c) they had a previous Nottingham Activities of Daily Living (ADL) scale [10] score of less than 6 (i.e. not able to toilet themselves independently) prior to the stroke.

Patients were further assessed for suitability by interviewing the nursing and medical staff. Patients were included unless they:

- (a) had other medical problems requiring continued treatment on an acute ward;
- (b) were expected to be discharged from hospital within 2 weeks;
- (c) were not able to tolerate rehabilitation (in half-hourly sessions) for at least 2 h each day;
- (d) had a Nottingham ADL scale [10] of 2 or less and were therefore very dependent on nursing care;
- (e) needed more than two nurses for bed to chair transfers, or
- (f) did not give their consent.

Patients were reviewed weekly for 5 weeks to determine whether they had become suitable for inclusion. Those who met the criteria before 5 weeks had elapsed following the stroke were included in the study.

Initial Assessment

Patients were assessed on the Barthel Index [11], Rivermead ADL scale (self-care section) [12], Rivermead Motor Assessment [13], Rey figure copy [14], Nottingham Sensory Assessment light touch and proprioception subscales [15] and Information/Orientation sections of the Cognitive Assessment Scale of the Clifton Assessment Procedure for the Elderly [16].

Clinical variables including side of stroke, age, sex, visual field deficits and communication problems were recorded from the medical notes.

Patients were stratified according to their admission ward, i.e. general medical or health care of the elderly. They were then randomly allocated either to the SU or to the control group. Initially, the ratio of SU to control group was 50:50, but in order to ensure that SU beds were fully occupied, after 1 year the ratio was altered to 60:40. The management of patients allocated to the control group remained the responsibility of their admitting physicians. Patients allocated to the SU were transferred within 2 days.

Outcome Measures

Patients were re-assessed, 3, 6 and 12 months after randomisation by an assessor who was 'blind' to their group allocation. Patients discharged from hospital were assessed at home or in their residential accommodation. Those in hospital were assessed in the Outpatient Rehabilitation Department at one hospital. All arrangements were made by a secretary so that the assessor remained unaware of the ward from which the patient had come.

Patients were assessed on:

- (1) Barthel Index [11];
- (2) Rivermead ADL scale (self-care and household subscales) [12];
- (3) Nottingham Extended ADL [17];
- (4) Rivermead Motor Assessment [13];
- (5) General Health Questionnaire [18];
- (5) Mood rating scales [19], and
- (6) Cognitive and Instrumental Readjustment scale [20].

Statistical Methods

Non-parametric statistical analyses were used: the χ^2 test to compare groups for nominal scale measures and the Mann-Whitney U test for ordinal scales.

Table 1. Initial characteristics of patients

	SU n = 176	CWs n = 139	Comparison
<i>Age</i>			
Median	69	68	U ^a = 11563
Range	26-88	38-89	p = 0.40
<i>Sex</i>			
Men	94 (53)	91 (65)	$\chi^2 = 4.18$ p = 0.04
Women	82 (47)	48 (35)	
<i>Previously living</i>			
Alone	58 (33)	38 (27)	$\chi^2 = 3.53$ p = 0.17
With other	118 (67)	99 (71)	
Institutional care	0 (0)	2 (2)	
<i>Side of body affected</i>			
Right	81 (46)	61 (44)	$\chi^2 = 3.02$ p = 0.39
Left	93 (53)	77 (55)	
Both	2 (1)	1 (1)	
<i>Visual fields</i>			
Normal	77 (44)	69 (50)	$\chi^2 = 4.29$ p = 0.37
Hemianopia alone	22 (13)	17 (12)	
Inattention alone	29 (16)	17 (12)	
Hemianopia and inattention	18 (10)	20 (14)	
Unable to test	30 (17)	16 (12)	
<i>Communication problems</i>			
Present	96 (54)	67 (48)	$\chi^2 = 1.01$ p = 0.31

Figures shown in parentheses are percentages.

^a Mann-Whitney U test.

Results

In the 30-month recruitment period, 1,760 patients were recorded on the stroke register. Of these, 29% died before being assessed; 21% were excluded as they were unconscious on admission to hospital, were previously very dependent or lived outside the immediately adjacent districts; 20% were due for imminent discharge and 12% were too ill (i.e.: those patients who had continuing medical problems, were not able to tolerate rehabilitation, or needed intensive nursing care).

There were 315 (18%) patients who met the criteria for inclusion, 174 from the general medical wards and 141 from the health care of the elderly wards. Of these, 176 patients were randomly allocated to the SU and 139 to the conventional wards.

The initial characteristics of the two groups are shown in table 1. Comparisons of the characteristics of the two groups show no statistically significant differences except that there was a higher proportion of women on the SU

(p = 0.04). Comparison of the groups on initial assessments also showed no significant differences except that patients on conventional wards had significantly higher scores on the arm section of the Rivermead Motor Assessment (p = 0.05), indicating better function.

There was no significant difference between the time of admission into hospital and randomisation (p > 0.05) (SU median 14 days CW median 14 days).

There was a statistically significant difference (p < 0.01) in the length of stay, with SU patients spending a median of 76 days (mean 81.1, SD 41.7, range 16-228) in hospital and conventional ward patients a median of 54 days (mean 63.2, SD 46.9, range 9-271).

Three months after randomisation, 275 patients were seen for assessment, 158 from the SU and 117 from the CWs. Comparison of non-assessment and partial completion of the assessments for the two groups showed no significant difference between the groups ($\chi^2 = 6.94$, p = 0.07). Partial completion of the assessments (n = 40) was due to communication problems, illness and refusal. Of the 18 patients not seen, this was because 3 had moved away, 5 refused, 3 were ill and 7 were not traced. Six months after randomisation, 259 patients were assessed, 150 from the SU and 109 from CWs. Comparison of the groups showed no significant difference in assessment rates ($\chi^2 = 2.87$, p = 0.41). Of the 25 patients not seen, 5 had moved away, 6 refused, 5 were ill and 9 were not traced. Twelve months after randomisation 241 patients were assessed, 144 from SU and 97 from CWs. Of the 21 patients not seen, 7 had moved away, 9 refused, 3 were ill and 2 were not able to be contacted. There was a significant difference in assessment rates ($\chi^2 = 10.4$, p = 0.02) with more SU patients completing all assessments and fewer being not seen or dead.

There was no statistically significant difference in the location of patients at 3, 6 or 12 months. There were similar proportions of patients at home at 3 (SU 58%, CW 64%) 6 (SU 69%, CW 64%) and 12 months (SU 65%, CW 62%). The proportion in institutions other than hospital increased with time but did not differ between the groups (3 months SU 12%, CW 15%; 6 months SU 16%, CW 17%; 12 months SU 18%, CW 16%). Of the survivors, significantly more SU patients remained in hospital at 3 months (SU 24%, CW 13%) but not at 6 or 12 months. There was no statistically significant difference in the proportion of SU patients who had died at either 3 months (SU 6%, CW 8%, OR 0.78, 95% CI 0.33-1.84), 6 months (SU 9%, CW 12%, OR 0.72, 95% CI 0.35-1.47) or 12 months (SU 14%, CW 19%, OR 0.72, 95% CI 0.39-1.31) after stroke.

Table 2. Comparison of outcome in functional abilities

	3 months				6 months				12 months			
	SU	CWs	compar.	effect size	SU	CWs	compar.	effect size	SU	CWs	compar.	effect size
<i>Barthel</i>												
Median	16.00	14.50	U ^a = 7131	+1	17.00	15.00	U = 6168	+1	17.0	16.00	U = 5893.5	+1
IQR	12-18	8-17	p = 0.02	(0-3.0)	13-19	10-18	p = 0.01	(0-3.0)	13-19	10-18	p = 0.08	(0-2.0)
<i>Rivermead ADL (self-care)</i>												
Median	11.0	8.00	U = 7037	+1	11.00	9.50	U = 6255	+1	12.00	9.0	U = 6172.5	+1
IQR	6-14	4-13	p = 0.03	(0-2.0)	6-14	5-13	p = 0.02	(0-2.0)	7-15	5-14	p = 0.10	(0-2.0)
<i>Rivermead ADL (household)</i>												
Median	3.00	1.00	U = 6363	+1	3.00	2.00	U = 6154	+1	3.00	2.00	U = 6073.5	+1
IQR	1-5	0-3	p < 0.001	(0-1.0)	1-7	0-5	p = 0.01	(0-1.0)	1-7	1-5	p = 0.06	(0-1.0)
<i>Extended ADL</i>												
Median	5.00	4.00	U = 5895	+1	6.00	4.00	U = 4656	+2	7.0	4.00	U = 3896.5	+2
IQR	2-9	2-9	p = 0.07	(0-2.0)	3-12	2-8	p = 0.01	(0-3)	4-12	2-10	p = 0.03	(0-3.0)

Figures in parentheses are 95% CI; IQR = interquartile range.
^a Mann-Whitney U test.

Comparison of outcomes on activities of daily living scales are shown in table 2. SU patients were significantly more independent in activities of daily living at both 3 and 6 months after stroke. By 12 months, they were not significantly different in personal ADL, as assessed on the Barthel Index, but remained significantly different in instrumental ADL, as assessed on the Nottingham Extended ADL scale. There were no significant differences between the groups on the Rivermead Motor Assessment.

On measures of mood and adjustment there were no significant differences between the groups at 3 months after randomisation. By 6 months there was no significant difference in mood but the SU patients showed significantly higher scores in cognitive adjustment (SU median 8, IQR 7-9; CW median 7, IQR 6-8; p = 0.001) and instrumental adjustment (SU median 8, IQR 6-11; CW median 7, IQR 6-9; p = 0.04). At 12 months, SU patients had significantly lower (better) scores on the GHQ (SU median 17, IQR 11-25; CW median 20, IQR 13-31; p = 0.04) but there were no significant differences on the simple mood-rating scales or adjustment measures.

Discussion

The present findings support previous work [3-6] indicating the benefit of SU care on early functional ability and demonstrate that the benefit is sustained 12 months

after stroke, though it reduces with time. Psychological adjustment and mood were improved, suggesting that SU care may be imparting skills, enabling patients to cope better with residual disability. Instrumental adjustment is the person's satisfaction with his/her level of functioning, in terms of potentials and physical capabilities and activity level compared to healthy persons. Cognitive adjustment is the individual's realistic assessment and understanding of his/her condition, and acceptance of his/her life as meaningful and purposeful despite the limitations imposed by the disease. Given that many patients had significant physical disability, then cognitive adjustment on its own could be considered a worthwhile outcome.

This study detected no significant difference in mortality, but the odds ratios are similar to those reported in a statistical overview of randomised controlled trials [10] and do not detract from the conclusion that SUs save lives.

This study differs from previous work in demonstrating that improved functional ability is achieved at the expense of a longer stay in hospital. One significant difference in baseline characteristics between the two groups is a predominance of women in the stroke unit group. Gender has not generally been found to influence speed of recovery after stroke [21]. Length of stay in an SU has been reported to be influenced by the presence or absence of a spouse or a carer at home [22]. Although there was no significant difference between the two groups on random-

isation, a third of SU patients lived alone compared with a quarter of those on CWs. Patients studied in this trial were approximately 10 years younger than those included in a similar study of a stroke rehabilitation unit [15]. Therapists may have persisted for longer with a younger patient who might cope alone rather than move to residential accommodation. The implications of a longer stay should be kept in perspective and considered in relation to the overall costs of stroke management in the 12 months after stroke. The length of stay on its own may have contributed to the better functional outcome on some measures, such as the Barthel Index. However, this seems unlikely as patients were usually discharged from hospital when they were considered to be no longer making progress with rehabilitation. Most outcome measures would be unlikely to be influenced by length of stay.

Nottingham SU is representative of many in the UK taking patients approximately 2 weeks after stroke. However, it may be that the impact of the SU was reduced because patients had already received considerable rehabilitation prior to randomisation. In addition, many of the therapists on CWs had received practical training in the SU as part of their rotating training posts, and considerable therapeutic expertise was available on CWs. In addition, both groups had access to the same out-patient

services, though that received was not recorded. These factors may have diluted the impact of SU care which nevertheless was still more effective.

The benefits of organised stroke rehabilitation now seem clear. It is important to establish which components of SU care most influence outcome, so that these aspects of stroke care may be enhanced in all settings where stroke rehabilitation occurs. Observations of the patients' activity and records of therapy sessions will provide some information to generate hypotheses about likely factors contributing to the difference. Analysis of the stratified subgroups will also enable more direct comparison with previously published work and illuminate the needs for different patterns of care to suit individual patients. This study has shown additional benefits over previously published studies, which support the more widespread provision of SUs for in-patient stroke rehabilitation.

Acknowledgements

We would like to thank the physicians of Nottingham hospitals for permission to include their patients, the staff of the Stroke Unit for agreeing to be evaluated, Dr. J. Gladman for assistance with patient recruitment, Mrs. P. Radley for preparing the manuscript and the Stroke Association for financial support.

References

- 1 Wolfe CD, Taub NA, Woodrow J, Richardson E, Warburton FG, Burney PGJ: Patterns of acute care in three districts of southern England. *J Epidemiol Commun Health* 1993;47:133-148.
- 2 Kings Fund Consensus Statement. Treatment of Stroke. *Br Med J* 1988;297:126-128.
- 3 Garraway WM, Akhtar AJ, Prescott RJ, Hockey L: Management of acute stroke in the elderly: Preliminary results of a controlled trial. *Br Med J* 1980;280:1040-1043.
- 4 Indredavik B, Bakke F, Solberg R, Rokseth R, Haaheim L, Holme I: Benefit of a stroke unit: A randomised controlled trial. *Stroke* 1991;22:1026-1031.
- 5 Kalra L, Dale P, Crome P: Improving stroke rehabilitation. *Stroke* 1993;24:1462-1467.
- 6 Garraway WM, Akhtar AJ, Hockey L, Prescott RJ: Management of acute stroke in the elderly: Follow-up of a controlled trial. *Br Med J* 1980;281:827-829.
- 7 Ebrahim S: *Clinical Epidemiology of Stroke*. Oxford, Oxford University Press, 1990.
- 8 Wade D, Langton Hower R, Skilbeck CE, David RM: *Stroke: A critical approach to diagnosis, treatment and management*. London, Chapman & Hall, 1985.
- 9 Langhorne P, Williams B, Gilchrist W, Howie K: Do stroke units save lives? *Lancet* 1993;342:395-398.
- 10 Ebrahim S, Nouri FM, Barer D: Measuring disability after stroke. *J Epidemiol Commun Health* 1985;39:86-89.
- 11 Collin C, Wade DT, Davis S, Horne V: The Barthel ADL Index: A reliability study. *Int Disabil Studies* 1988;10:61-63.
- 12 Lincoln NB, Edmans JA: A re-validation of the Rivermead ADL scale for elderly stroke patients. *Age Ageing* 1990;19:19-24.
- 13 Lincoln NB, Leadbitter D: Assessment of motor function in stroke patients. *Physiotherapy* 1979;68:48-51.
- 14 Spreen O, Strauss E: *A Compendium of Neuropsychological Tests*. Oxford, Oxford University Press, 1991, pp 157-167.
- 15 Lincoln NB, Crow JL, Jackson JM, Waters GR, Adams SA, Hodgson P: The unreliability of sensory assessments. *Clin Rehab* 1991;5:273-282.
- 16 Pattie A, Gilleard C: *Clifton Assessment Procedures for the Elderly*. Windsor, NFER-Nelson, 1979.
- 17 Nouri FM, Lincoln NB: An extended ADL scale for use with stroke patients. *Clin Rehabil* 1987;1:301-305.
- 18 Goldberg DP, Hillier VF: A scaled version of the General Health Questionnaire. *Psychol Med* 1979;9:139-145.
- 19 Lincoln NB, Jones AJ, Mulley GP: Psychological effects of speech therapy. *J Psychosom Res* 1985;29:467-474.
- 20 Ben Sira Z, Eliezer R: The structure of readjustment after heart attack. *Soc Sci Med* 1990;30:523-536.
- 21 Wood-Dauphinee S, Shapiro S, Bass E, Fletcher C, Georges P, Hensby V, Mendelsohn B: A randomised trial of team care following stroke. *Stroke* 1984;15:864-872.
- 22 Lincoln NB, Jackson JM, Edmans JA, Walker MF, Farrow VM, Latham A, Coombes K: The accuracy of predictions about progress of patients on a stroke unit. *J Neurol Neurosurg Psychiatry* 1990;53:972-975.