Patient outcomes and length of stay in a stroke unit offering both acute and rehabilitation services

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IT IS WELL ESTABLISHED that treating patients with stroke in specialised stroke units reduces mortality,[1-7] institutionalisation[1,2,6] and length of hospital stay,[1,5] and improves functional status.[2,5-7] However, there are many different models of stroke unit, and few data on the model that gives the best outcomes. The latest analysis by the Stroke Unit Trialists' Collaboration (Cochrane Library) found greater benefits in units based in a discrete ward,[8] but these results were not statistically convincing, and more information is required.

Bankstown–Lidcombe Hospital is unique in New South Wales in having a comprehensive, dedicated stroke unit that provides both acute and rehabilitative care. Most other stroke rehabilitation units in the State are mixed rehabilitation wards (which treat a range of patients with disabling illness, not only stroke patients), and no others combine acute stroke management and rehabilitation. Comprehensive, dedicated stroke units have the potential to reduce length of stay and improve functional outcome, as rehabilitation can be started earlier, without the need for patient transfer from acute to rehabilitation facilities. However, the potential advantages of this model of stroke unit have not been adequately explored.

Our study aimed to compare length of stay and outcomes of rehabilitation between patients managed in the stroke unit at Bankstown–Lidcombe Hospital and those managed in other stroke rehabilitation units in NSW. A secondary aim was to compare length of stay and mortality between patients receiving acute care in the stroke unit and those managed elsewhere in NSW.

ABSTRACT

Objectives: To compare hospital length of stay (LOS) and outcome after stroke between patients in a stroke unit offering combined acute and rehabilitation services and patients treated elsewhere in New South Wales.

Design: Retrospective audit of two hospital databases (Diagnosis-Related Groups [DRG] database and Australian National Subacute Non-Acute Patient Classification System [AN-SNAP] database), with comparison with DRG and AN-SNAP data for NSW.

Setting and participants: 242 episodes of acute stroke in patients admitted to the stroke unit of a metropolitan teaching hospital between July 1999 and November 2000, 113 of whom also underwent rehabilitation in the unit; 9777 episodes of acute stroke in the NSW DRG database, and 2350 in the NSW AN-SNAP database.

Main outcome measures: Acute and rehabilitation LOS; mortality in acute care; FIM (Functional Independence Measure) score at discharge and change in FIM score; and discharge destination.

Results: Patients in the combined stroke unit had shorter LOS and better functional outcome in all DRG and AN-SNAP groups, with both higher discharge FIM scores and greater gain in FIM scores than NSW patients. Acute stroke mortality of 12% and nursing home admission rate of 15.5% in the combined stroke unit were not significantly different from rates for NSW (15.7% and 11.2%, respectively).

Conclusions: Combining acute and rehabilitation services in a stroke unit may reduce LOS and improve functional outcome of patients with acute stroke.

METHODS

This was a retrospective study, drawing on casemix information. It was approved by the Ethics Committee of the Southwestern Sydney Area Health Service.

Bankstown–Lidcombe Stroke Unit

A comprehensive, dedicated stroke unit was established in May 1998 at Bankstown–Lidcombe Hospital (a 450-bed, metropolitan teaching hospital in Sydney, NSW). The unit has 20 beds and is staffed by a multidisciplinary team of neu-rologists, geriatricians, a rehabilitation physician, nurses, physiotherapists, occupational therapists, speech pathologists, dietitians, social workers and an orthoptist. Patients diagnosed with stroke are admitted directly to the unit from the emergency department, unless the unit is already full. As well as acute medical management, the unit provides rehabilitation as soon as the patient's medical condition allows, often starting on Day 1 or 2 of admission. Multidisciplinary meetings are held weekly to plan rehabilitation goals, discuss patient progress and coordinate discharge planning.

Data sources and extraction

Information on all patients admitted to the stroke unit with acute stroke between July 1999 and November 2000 was extracted from two databases of Bankstown–Lidcombe Hospital. Information on acute stroke episodes was obtained from the DRG (Diagnosis-Related Groups) database and on rehabilitation

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from the AN-SNAP (Australian National Subacute Non-Acute Patient Casemix Classification System) database.

The Australian Refined Diagnosis Related Group (AR-DRG) classification system[9] is used to describe the acute inpatient casemix of a hospital. Version 4.1 of the system, introduced in July 1999, defines acute stroke as classes B70A–D (Box 1). These incorporate the principal ICD-10 diagnoses of all types of ischaemic stroke (including cortical, subcortical, brainstem and lacunar infarcts) and non-traumatic primary haemorrhagic strokes.[10] Data were extracted from the DRG database on patient demographic and clinical characteristics, DRG class, LOS, mortality and hospital readmissions within 28 days.

1: Definitions of DRG and AN-SNAP classes of stroke

DRG classes*
B70A: With severe or complicating diagnosis/procedure (eg, septicaemia, pneumonia or pulmonary embolism)
B70B: With other complications/comorbidities
B70C: Without other complications/comorbidities
B70D: Died or transferred < 5 days

AN-SNAP classes†
203: Motor score, 13
204: Motor, 63–91; cognition, 20–35
205: Motor, 63–91; cognition, 5–19
206: Motor, 47–62
207: Motor, 14–46; age ⩾ 75 years
208: Motor, 14–46; age ⩽ 74 years

* From version 4.1 of the Australian Refined Diagnosis Related Group (AR-DRG) classification system.[9]
† From the Australian National Subacute Non-Acute Patient Casemix Classification System (AN-SNAP),[11] based on Functional Independence Measure (FIM) scores.[12]

The AN-SNAP casemix classification system[11] has been used by the 48 rehabilitation units in NSW to classify rehabilitation patients since July 1998. It classifies stroke episodes on the basis of patient age and Functional Independence Measure (FIM) scores[12] on admission (Box 1). The FIM is similar to the commonly used Barthel Index, but includes a cognition subscale (five items — comprehension, expression, social interaction, problem solving and memory), as well as a motor subscale (13 items, including self-care [bathing, grooming, toileting, eating and dressing], sphincter control, transfers, and mobility). Each item is scored on a seven-point ordinal scale (1 = total assistance, 7 = complete independence), giving a total FIM score of 18–126. The FIM has high reported reliability and validity.[13-14] We identified patients with acute stroke who went on to have rehabilitation in the stroke unit in the AN-SNAP database by their unique medical record numbers, and extracted information on AN-SNAP class, FIM scores, rehabilitation LOS and discharge destination. Patients in the stroke unit were reclassified as rehabilitation patients when they were medically stable with regard to neurological deficits and complications, and deemed fit for intensive rehabilitation.

To compare acute stroke outcomes, we obtained AR-DRG data for NSW for the period July 1999 to June 2000 from the NSW Health Department. To compare rehabilitation outcomes, we extracted data on stroke rehabilitation episodes, excluding those at Bankstown–Lidcombe Hospital, for the period July 1999 to November 2000 from the NSW AN-SNAP database.

Statistical analysis

Data were analysed using SPSS version 9.0.[15] Patient characteristics were compared using χ^2 or t tests, while outcomes were compared using χ^2 tests (categorical outcomes) and the non-parametric Mann–Whitney U test (continuous outcomes). Linear regression was used to adjust and test for statistical interaction. P values for linear regression model comparisons were obtained using the likelihood ratio test.

RESULTS

Acute stroke episodes

Between July 1999 and November 2000, 233 patients were admitted to our stroke unit with a total of 242 acute stroke episodes; 148 were admitted directly from the emergency department (61% of episodes), 81 were transferred from general medical wards (34%) and 11 from other hospitals (5%), and two were admitted directly from home.

During the year July 1999 to June 2000, there were 9777 acute stroke episodes among patients admitted to NSW hospitals.

Patient characteristics: Patients receiving acute care in our stroke unit did not differ significantly from NSW patients with stroke in age (mean age [SD], 74.0 [12.2] v 72.7 [14.9] years for NSW) or sex distribution (50% male v 49% for NSW). However, a smaller proportion of patients in our unit were married (34% v 48% for NSW; $\chi^2 = 16.85$; 1 df; $P < 0.001$). There were also no significant differences in frequencies of hypertension, diabetes mellitus, atrial fibrillation/flutter, hyperlipidaemia and dementia, but a smaller proportion of patients at our unit had ischaemic heart

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2: Characteristics and acute length of stay of patients with acute stroke in Bankstown–Lidcombe stroke unit and throughout New South Wales

	Number of patients (%)			Mean length of stay in acute care (days)			
DRG class	**Bankstown–Lidcombe stroke unit (n=242)**	**Bankstown–Lidcombe non-stroke unit (n=177)**	**NSW (n=9777)**	**Bankstown–Lidcombe stroke unit (n=242)**	**NSW (n=9777)**	**Difference* (95% CI)**	***P†***
B70A	117 (48%)	37 (21%)	3261 (33%)	12.7	14.5	−1.8 (−3.5 to −0.2)	0.03
B70B	93 (38%)	39 (22%)	3121 (32%)	8.9	9.6	−0.7 (−1.9 to 0.4)	0.21
B70C	19 (8%)	16 (9%)	1391 (14%)	6.7	7.8	−1.1 (−3.2 to 1.0)	0.29
B70D	13 (5%)	85 (48%)	2004 (21%)	NA	NA	NA	NA

NA = not assessed.
* Difference in mean LOS between the stroke unit and throughout NSW. † For comparison of mean LOS between the stroke unit and throughout NSW.

3: Characteristics of patients undergoing rehabilitation at the Bankstown–Lidcombe stroke unit and elsewhere in NSW

AN-SNAP class	Number of patients (%)		Mean FIM score on admission (SD)		
	Stroke unit (n=113)	NSW (n=2350)	Stroke unit (n=113)	NSW (n=2350)	P*
203	29 (26%)	83 (4%)	20.9 (7.9)	23.2 (6.7)	0.02
204	13 (12%)	655 (28%)	106.4 (8.3)	105.7 (9.6)	0.72
205	4 (4%)	82 (4%)	85.0 (6.1)	86.8 (9.1)	0.74
206	16 (14%)	535 (23%)	81.3 (10.0)	80.4 (9.4)	0.67
207	28 (25%)	503 (21%)	48.3 (15.7)	50.8 (14.9)	0.43
208	23 (20%)	492 (21%)	44.0 (14.5)	51.5 (15.2)	0.02

FIM = Functional Independence Measure. *For comparison of mean FIM score on admission between patients undergoing rehabilitation at the stroke unit and elsewhere in NSW.

disease (17% v 24% for NSW; $\chi^2 = 6.73$; 1 df; $P = 0.01$).

Outcomes: Patients in our stroke unit had shorter LOS for acute stroke than NSW patients, reaching statistical significance for DRG class B70A (Box 2). There was also a trend for a lower mortality rate for acute stroke episodes in our stroke unit (12% v 15.7% for NSW; $\chi^2 = 2.5$; 1 df; $P = 0.11$) and a slightly lower 28-day readmission rate (5% v 5.8% for NSW; $\chi^2 = 0.31$; 1 df; $P = 0.58$). However, further analysis by DRG class showed no significant differences between stroke-unit and NSW patients in mortality and readmission rates.

Rehabilitation episodes

Patient characteristics: Patients undergoing rehabilitation in our stroke unit did not differ significantly from those undergoing rehabilitation elsewhere in NSW in either age (mean age [SD], 73.5 [11.1] v 72.1 [12.5] years) or sex distribution (% male: 47% v 50%). However, our patients had lower mean FIM score on admission than NSW patients in most AN-SNAP classes (Box 3), although the differences were significant only for classes 203 and 208.

Outcomes: Patients in our stroke unit had shorter mean rehabilitation LOS and greater change in FIM scores than patients elsewhere in NSW, even after adjustment for patient age and FIM score at admission to rehabilitation (Box 4). Our patients also had higher mean FIM scores at discharge after adjustment for age. There was no significant statistical interaction with AN-SNAP class, implying that the differences seen were consistent across all AN-SNAP classes. There were no significant differences in the proportion of patients discharged to nursing homes between patients undergoing rehabilitation in our unit and elsewhere in NSW (15.5% v 11.2%; $\chi^2 = 1.9$; 1 df; $P = 0.17$).

Non-stroke-unit patients

During the study period, 171 patients with 177 acute stroke episodes were admitted to wards of Bankstown–Lidcombe Hospital other than the stroke unit. Mean age was 70.9 years (SD, 14.1), and 48% were male. DRG classification is shown in Box 2. About half (85) of these episodes were classed as B70D ("died or transferred out of the hospital in under five days"). Non-stroke-unit patients had shorter mean LOS (mean LOS for DRGs B70A, B70B and B70C were 10.0, 7.1 and 5.6 days, respectively), but a higher acute stroke mortality rate (16%) and a higher 28-day readmission rate (19%) than the stroke unit.

DISCUSSION

Our study showed that combining acute and rehabilitation services in a stroke unit may improve patients' functional outcomes and reduce length of hospital stay. Possible reasons for the shorter LOS in acute care in our stroke unit compared with NSW as a whole were that patients did not need to wait for a rehabilitation bed or that their classification was shifted early from acute to rehabilitation. However, rehabilitation LOS was also shorter in our unit, demonstrating an overall benefit.

LOS in our stroke unit may have been reduced because of the immediate availability of intensive physiotherapy during acute care. As our patients were not transferred for rehabilitation, they did not need to adjust to a new environment, which may hinder recovery, especially among elderly patients, or

4: Rehabilitation length of stay (LOS) and functional outcome in the stroke unit at Bankstown–Lidcombe Hospital compared with elsewhere in New South Wales

AN-SNAP class	Mean LOS in rehabilitation (days)				Mean FIM score at discharge				Mean change in FIM score			
	Stroke unit	NSW	Difference* (95% CI)	P†	Stroke unit	NSW	Difference* (95% CI)	P†	Stroke unit	NSW	Difference* (95% CI)	P†
203	27.0	42.2	−10.4 (−23.5 to 2.7)	0.12	45.7	34.0	13.7 (3.1 to 24.2)	0.01	24.7	10.9	17.5 (8.2 to 26.9)	< 0.001
204	14.4	17.3	−2.8 (−8.6 to 3.0)	0.34	119.8	115.4	4.4 (−1.3 to 10.0)	0.13	13.5	9.7	4.0 (−0.9 to 9.0)	0.11
205	12.0	23.0	−11.3 (−25.8 to 3.3)	0.13	109.8	101.4	7.1 (−6.8 to 21.0)	0.31	24.8	14.6	8.7 (−3.3 to 20.6)	0.16
206	19.5	28.1	−8.6 (−16.9 to −0.34)	0.04	111.4	100.9	10.0 (0.9 to 19.1)	0.03	30.1	20.6	9.1 (1.2 to 17.1)	0.02
207	22.7	38.3	−16.1 (−25.0 to −7.2	< 0.001	82.8	69.5	12.8 (2.1 to 23.5)	0.02	34.5	18.7	15.9 (7.9 to 24.0)	< 0.001
208	29.7	42.3	−13.1 (−24.6 to −1.5)	0.03	88.9	77.7	12.8 (1.9 to 23.8)	0.02	44.8	26.2	19.5 (10.1 to 28.9)	< 0.001
Overall	23.4	30.6	−13.6 (−17.6 to −9.7)	< 0.001	83.8	91.0	−6.7 (−12.3 to −1.0)	0.02	30.7	17.8	10.3 (6.8 to 13.8)	< 0.001

FIM = Functional Independence Measure.
*Difference in means between the stroke unit and elsewhere in NSW (adjusted for age and admission FIM score for rehabilitation LOS and change in total FIM score, and adjusted for age for discharge total FIM score). † For comparison of means between the stroke unit and elsewhere in NSW.

undergo assessment by a new team of doctors and therapists. Although availability of outpatient and domiciliary rehabilitation services may allow earlier patient discharge, this was probably not a factor in our patients' shorter LOS, as Bankstown does not have a strong domiciliary rehabilitation team, and most rehabilitation in the region is done on an inpatient basis.

Despite our patients' shorter LOS in rehabilitation, their functional outcomes at discharge were better than those in patients elsewhere in NSW, probably because of the early initiation of rehabilitation in our unit.[16-18] The greater increase in FIM score in our patients was expected, as their scores at admission were lower, attributable to their earlier reclassification as rehabilitation rather than acute patients. However, our patients also had higher mean FIM scores at discharge. Coupled with their shorter length of stay, this increases the robustness of our results, as functional gain is expected to increase with longer hospital stay.[19]

Confounding factors that may affect rehabilitation outcome are stroke severity (which is reflected in the level of function on admission),[17,20-22] patient age,[18,20-22] presence of medical comorbidities,[20,23] and intensity of rehabilitation.[17] We adjusted for age in our analysis, and also attempted to control for stroke severity by comparing outcomes within AN-SNAP classes and adjusting for FIM score on admission. Although AN-SNAP class and FIM score on admission may not be adequate measures of stroke severity, no better measures (such as score on the Scandinavian Stroke Scale[24]) are included in the AN-SNAP database. This is a limitation of our study. The lack of data on comorbidities and intensity of rehabilitation is a further limitation.

Another potential limitation is the concern that DRG and AN-SNAP data may not be totally robust. To ensure quality control of FIM scoring, weekly one-hour training sessions have been held for staff in the stroke unit since its implementation. These are conducted by a senior occupational therapist who is an accredited FIM trainer. Similar training programs have been held in rehabilitation units throughout NSW.

We found no statistical difference in rates of nursing home admission between rehabilitation patients in our stroke unit and elsewhere in NSW. However, being unmarried and not having a caregiver are both associated with institutionalisation,[23,25] and acute patients in our stroke unit were less likely to be married than NSW patients (the AN-SNAP database does not record marital status).

Although the policy at Bankstown–Lidcombe Hospital is to admit patients with stroke to the stroke unit whenever possible, in 177 episodes of acute stroke patients were admitted to other wards because insufficient beds were available in the stroke unit. About half these patients were classified DRG class B70D ("died or transferred out of the hospital in under five days"), compared with 5% of stroke-unit patients. Non-stroke-unit patients also had higher acute mortality. However, this would not affect LOS comparisons between stroke-unit and NSW patients, as data were stratified by DRG class, with class B70D excluded from the analyses. Furthermore, in other DRG classes (B70A–C), LOS was uniformly shorter in patients treated outside the stroke unit. Therefore, the exclusion of these patients did not account for the lower LOS in the stroke unit compared with NSW as a whole. There were no rehabilitation data for non-stroke-unit patients, as AN-SNAP data are collected only for those in the stroke unit. However, it was not our aim to compare outcomes between the stroke unit and general medical wards.

A controlled trial with randomisation at onset of acute stroke would provide the best comparison of different types of stroke services, but has practical difficulties. Despite the limitations of our study, it provides preliminary evidence of the benefits of a comprehensive, dedicated stroke unit in reducing length of hospital stay and improving functional outcomes in patients with stroke.

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