

# The contribution of a comprehensive stroke unit to the outcome of Chinese stroke patients

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## ABSTRACT

**Introduction:** There are significant differences in stroke patterns and risk factors for cerebrovascular disease between Chinese subjects and Caucasians. The outcome of stroke unit care in a Chinese population has not been described in the medical literature. The present study aims to evaluate the outcome of stroke unit care in Chinese subjects.

**Methods:** By prospective comparative research, Chinese patients treated in the stroke unit were group-matched with those treated in the general medical ward by age, gender, premorbid functional status (by the Barthel Index), National Institute of Health Stroke Scale score, and stroke types. From April 2001 to April 2002, a total of 188 patients in the stroke unit group and 177 patients in the general ward group were recruited in the study. The main outcome measures included mortality at 28 and 120 days, and the length of inpatient stay.

**Results:** Stroke unit care significantly reduced mortality of patients with acute stroke after 28 and 120 days. After 28 days, mortality was 3.3 percent and 17.2 percent for the stroke unit group and general ward group, respectively (p-value is equal to or less than 0.01); whereas after 120 days, mortality was 5.0 percent and 24.7 percent for the stroke unit group and general ward group, respectively (p-value is equal to or less than 0.001). The stroke unit care was demonstrated, by logistic regression analysis, to have contributed to the reduction of mortality at 120 days (p-value is 0.014). At 28 days, there was only a trend for stroke unit care to contribute to the reduction of mortality by logistic regression analysis (p-value is 0.067). By Kaplan-Meier survival curves (log rank statistic is 10.46, p-value

is 0.001) and a Cox regression (hazard ratio 0.253, 95 percent confidence interval 0.085 to 0.754, p-value is 0.014), the stroke unit care was further found to reduce mortality significantly. The mean length of inpatient stay of the stroke unit group was 37.1 days, while that of the general medical ward group was 69.3 days (p-value is equal to or less than 0.001).

**Conclusion:** Chinese subjects receiving comprehensive stroke unit care are associated with less mortality and shorter length of hospital stay than those having conventional care in general medical wards.

**Keywords:** cerebrovascular disorders, general wards, outcome assessment, stroke, stroke unit

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## INTRODUCTION

Within Asia, stroke is a major cause of death and disability, and the burden of stroke in this region is predicted to increase<sup>(1)</sup>. The incidence of ischaemic and haemorrhagic stroke in Asia is higher than in Europe and America, and a greater proportion of strokes are due to cerebral haemorrhage, for which the outcome is poor<sup>(1)</sup>. Anecdotal evidence suggests that Chinese populations are associated with a higher incidence of severe intracranial carotid disease than Caucasian populations<sup>(2)</sup>. Perhaps the most significant advance in stroke management is not by pharmacotherapy, but rather concerns the process or system of care. None of the neuroprotective agents has ever been found to be effective in human trials despite promising animal data<sup>(3-6)</sup>. Thrombolytic therapy is just suitable for a certain group of patients with hyperacute ischaemic stroke because of the restricted therapeutic window and hampering side effect of haemorrhage<sup>(3,7,8)</sup>.

A Cochrane systematic review identified 23 trials, and found stroke patients who received

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organised inpatient care in a stroke unit were more likely to be alive, independent, and living at home one year after the stroke. No systemic increase was observed in the length of inpatient stay<sup>(9)</sup>. All the studies mainly came from the Western countries. Due to the existence of racial, geographical, cultural and infrastructure differences, such studies from the Western developed countries cannot be extrapolated to reflect the situation in Asian populations. Despite all these factors, the outcome of stroke unit care in a Chinese population has not been described in the medical literature. A study to evaluate the outcome of stroke unit care in Chinese subjects is warranted.

## METHODS

Patients with all types of stroke, except those due to transient ischaemic attack, subarachnoid haemorrhage and subdural haematoma, admitted either to the stroke unit or the general medical wards in Kwong Wah Hospital of Hong Kong, from April 2001 to April 2002, were studied. Because of limited beds in the comprehensive stroke unit, patients who could not be admitted to the stroke unit had to be managed in the general medical ward. Data of all patients with acute stroke admitted into the Department of Medicine and Geriatrics were prospectively entered into spreadsheets. Then, patients treated in the stroke unit were group-matched with those subjects treated in the general medical ward by age, gender, premorbid functional status (by Barthel Index), National Institute of Health Stroke Scale (NIHSS), and stroke types<sup>(10)</sup>.

The inclusion criteria were: acute stroke patients (within 72 hours of onset) of moderate to severe severity (i.e. NIHSS >3) (so that neurological deficits were present and could be measured); good premorbid condition (i.e. Barthel Index >90) (so that patients were independent in daily living); and no upper age limit. The exclusion criteria were: (1) Patients with coexisting severe medical conditions, such as renal, cardiac, hepatic or metabolic disease. (2) Patients with subarachnoid haemorrhage and subdural haematoma. (3) Patients with concomitant rapidly-fatal disease within one year. (4) Unconscious patients due to "irreversible" causes (e.g. raised intracranial pressure). Impairment of consciousness due to reversible causes like pneumonia was not an exclusion criterion. (5) Patients with acute head injury. (6) Patients with other neurological diseases, such as Parkinson disease, Alzheimer dementia, progressive suprabulbar palsy and brain tumour.

Medical treatment regimes, pharmacotherapy, nursing care and rehabilitation methods, ward designs and environment were similar for both groups in the stroke unit and the general medical ward. Patients in either the stroke unit or the general wards were under the same department, and therefore under the care of the same group of professionals, including neurologists, physicians, physiotherapists, occupational therapists, neuropsychologist, speech therapist and social workers.

Data analyses were performed by the Statistical Package for Social Sciences (SPSS) for Windows version 10.0 (Chicago, IL, USA). In all analyses, a probability value of <0.05 was considered significant. The odd ratios were calculated to indicate the magnitude of outcome difference between the stroke unit and general ward group, and logistic regression analysis was used to test for the independent variables, including the influence of stroke unit treatment on mortality. Kaplan-Meier survival curves were drawn, and the difference between the curves was analysed with the log-rank test. Cox regressions were performed to get the estimated hazard ratios with their confidence intervals by using the explanatory covariates for the effect on survival.

## RESULTS

There were a total of 188 patients in the stroke unit group and 177 patients in the general ward group recruited by the group matching method. No significant difference existed concerning age, sex, and premorbid status between the two studied groups. The age of the subjects ranged from 38 to 93 years, and the male to female ratio was approximately 3:2. 18.1% in the stroke unit group and 11.3% in the general medical ward group had intracerebral bleeding demonstrated by computed tomography (CT). Although haemorrhagic strokes were slightly more frequent in the stroke unit group than in the general ward group, the difference was not statistically significant (95% CI -0.140 to 0.006).

The stroke unit group had lower mortality rate at the time of discharge and more patients who were discharged home (Table I). The mean length of inpatient stay of the stroke unit group was 37.1 days, while that of the general medical ward group was 69.3 days ( $p \leq 0.001$ ). After 28 days, mortality was 3.3% for stroke unit group, and 17.2% for the general ward group ( $p \leq 0.01$ , 95% CI -0.210 to -0.075). Poor outcome (which included death and institutionalisation) was 6% for the stroke unit treated group, and 20.5% for the general medical

**Table I. Discharge status.**

Test	Status	Stroke unit	General ward	p-value	95% CI
chi-square	Death	5/188 (2.7%)	21/177 (11.9%)	0.001	
(X <sup>2</sup> ) test	Old age home	4/188 (2.1%)	5/177 (2.8%)	0.463	
	Convalescent hospital	77/188 (41.0%)	79/177 (44.6%)	0.526	
	Home	93/188 (49.5%)	70/177 (39.6%)	0.059	
t-test	Mean LOS in acute hospital and convalescent hospital	37.1 days (SD 26.2)	69.3 days (SD 59.5)	<0.001	-41.8 to -22.6

Los: length of stay; SD: standard deviation; CI: confidence interval.

**Table II. Variables contributing to mortality using logistic regression analysis.**

Explanatory variables	B	SE	p-value	OR	95% CI
<b>At 28 days</b>					
Age	0.003	0.021	0.890	1.003	0.958 - 1.050
Premorbid Barthel Index	-0.011	0.087	0.915	1.003	0.956 - 1.051
NIHSS	0.157	0.015	<0.001	1.170	1.16 - 1.227
Stroke unit	-0.956	0.482	0.067	0.385	0.131 - 1.071
<b>At 120 days</b>					
Age	0.015	0.018	0.450	1.015	0.976 - 1.057
Premorbid Barthel Index	0.047	0.078	0.604	1.048	0.178 - 1.251
NIHSS	0.141	0.013	<0.001	1.151	1.104 - 1.2
Stroke unit	-1.062	0.395	0.014	0.346	0.149 - 0.803

OR: odds ratio; NIHSS: National Institute of Health Stroke Scale.

**Table III. Cox regression of the factors contributing to survival.**

Factors	B	SE	HR	95% CI	p-value
Stroke unit	-1.375	0.557	0.253	0.085, 0.754	0.014
Stroke severity by NIHSS	0.115	0.019	1.122	1.081, 1.164	<0.001
Premorbid Barthel Index	0.152	0.144	1.164	0.878, 1.543	0.292
Age	-0.02	0.021	0.980	0.941, 1.020	0.327

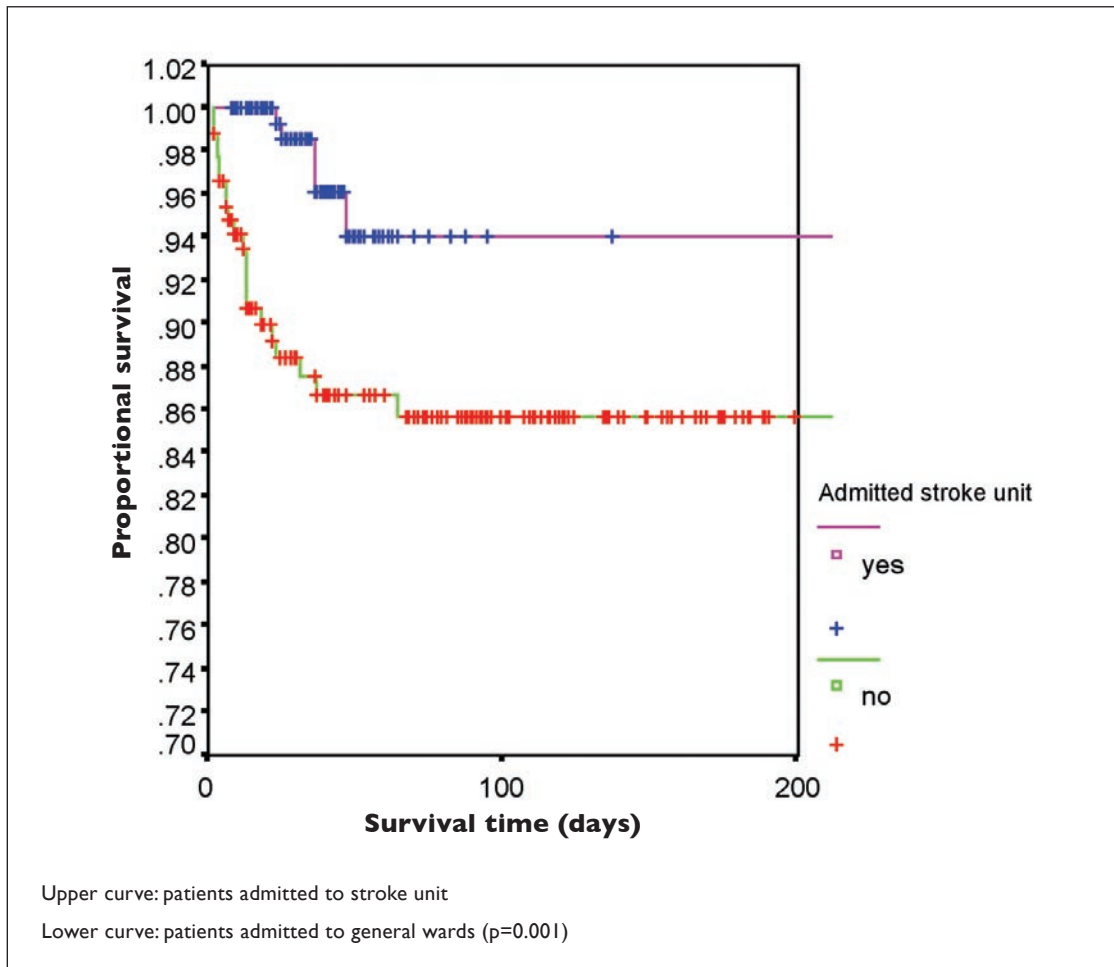
HR: hazard ratio.

ward treated group ( $p \leq 0.01$ , 95% CI -0.221 to -0.073). After 120 days, mortality was 5% for the stroke unit treated group, and 24.7% for the general ward treated group ( $p \leq 0.001$ , 95% CI -0.277 to -0.120). Poor outcome became 15.6% in the stroke unit group, and 40.1% in the general ward group ( $p \leq 0.001$ , 95% CI -0.339 to -0.147). Like the results at 28 days, the Barthel Index remained similar between the two groups.

At 28 days, there was only a trend for stroke unit care to contribute to the reduction of mortality ( $p=0.067$ ) by logistic regression analyses (Table II). At 120 days, the factor of having been with stroke unit care was then confirmed to have significant beneficial influence on mortality ( $p=0.014$ ). While stroke severity (assessed by NIHSS) was demonstrated to be significantly associated with

mortality at 28 and 120 days by logistic regression analyses, the factors of age and premorbid Barthel Index did not show any significant contribution.

The Kaplan-Meier survival curves (Fig. 1) demonstrated that there was less mortality in the stroke unit group than in the general ward group during the first 120 days (log rank statistic=10.46,  $p=0.001$ ). The later parts of the curves are horizontal since there was not any further data entry after 120 days. The covariates: stroke severity (NIHSS), stroke unit care, age and premorbid functional status (assessed by Barthel Index), were further analysed by Cox regression model. Stroke unit care (hazard ratio 0.253, 95% CI 0.085 to 0.754,  $p=0.014$ ) and stroke severity by NIHSS (hazard ratio 1.122, 95% CI 1.081 to 1.164,  $p \leq 0.001$ ) were found to be significantly associated with survival,



**Fig. 1** Kaplan-Meier survival curves for different strategies of care after acute stroke. (log-rank test)

while the other factors, such as age and premorbid Barthel Index, were not (Table III).

## DISCUSSION

This prospective study by group-matching stroke unit patients with general ward stroke patients evaluates stroke unit care on the outcome of Chinese subjects with acute stroke. It has shown that stroke patients treated in a stroke unit have a better outcome and shorter length of inpatient stay than those treated in general medical wards. The therapies were the same for both stroke unit and general ward treated group. There is no indication that the differences in outcome were due to patient differences. It needs to be mentioned that there are significant differences in stroke patterns and risk factors for cerebrovascular disease between Chinese subjects and Caucasians<sup>(11-14)</sup>. In spite of these factors, the findings in the study are in accordance with the findings of reduced short-term mortality in stroke units in prior trials, including randomised trials in the western populations<sup>(9,15-20)</sup>.

Studies had previously shown that intracerebral haemorrhage had an independent influence on prognosis, when taking into account the initial stroke severity<sup>(21)</sup>. Although a slightly higher proportion of intracerebral haemorrhage was included in the stroke unit group, less mortality and poor outcome occurred in the group. Age did have a small influence on the activities of daily living (ADL) outcome, but it had no independent influence on mortality, discharge placement to a nursing home, neurological impairment after rehabilitation, and length of hospital stay<sup>(22)</sup>. This study equally did not find age as a factor to the mortality rate at 28 and 120 days. The most readily-available and frequently-cited measure for assessing the disease is total mortality<sup>(23)</sup>.

Mortality was 3.3% for stroke unit group and 17.2% for the general ward group after 28 days. For the sake of comparison, early case-fatality rates for ischaemic stroke currently range from 5.8% to 20.4% in the medical literature<sup>(24-27)</sup>. In the UK Oxfordshire Community Stroke Project, the 28-day case fatality was 19% overall<sup>(28)</sup>.

In the literature, the reasons for why stroke unit care works better is still under discussion<sup>(29)</sup>. Possibilities include: the systematic and coordinated multidisciplinary assessment, intervention and maintenance of physiological homeostasis, greater success in preventing complications due to earlier mobilisation and rehabilitation, more attention to preventive measures, selective use of antipyretics, antibiotic medication and insulin, better training and greater dedication of professional staff, and emphasis on patient and family education and involvement in care<sup>(29,30)</sup>. While the debate among these causes has not been unequivocally resolved, the prevention of secondary complications by early rehabilitation and shorter time to mobilise patients by better organisation and coordination appear to be a single important cause.

Of the contributory factors under study, stroke severity by NIHSS was found to be highly significant in influencing survival of stroke patients. The beneficial effect of stroke unit care was proven by the Kaplan-Meier survival curves. Logistic regression analyses confirmed its beneficial effect at 120 days but not 28 days. Cox regression model, which takes hazard ratios into calculation, further showed that stroke unit care was associated with reduced mortality<sup>(31)</sup>. A weakness in a study of this type is the lack of blinding. In comparing stroke unit treatment and treatment in general wards at the same hospital, it would be difficult to prevent dissemination of the programme and methods used on the stroke unit to the general wards (treatment contamination). Type I error is particularly possible in the difference in mortality between the stroke unit and general medical wards due to small numbers, because mortality was not taken into consideration in determination of sample size.

Given the results, this research indicates that stroke unit care is beneficial to Chinese patients with acute stroke by improving their outcomes. Any nihilism surrounding stroke care is therefore unjustified. Since stroke is such a common disease, even small acute treatment effects (of the order of a few percent improvements in outcome) may be useful if considered in the context of the whole population.

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