

A Review of the Role of Stroke Units in the Modern Day Management of Stroke – Implications for Stroke Care in Singapore

N Venketasubramanian

ABSTRACT

Among the strategies to combat stroke, an important cause of mortality and morbidity in Singapore, is the establishment of stroke units. Stroke units are characterised by a geographical co-location of stroke patients or care by a mobile multidisciplinary stroke team of specialists; the provision of 24-hour CT scanning, laboratory, monitoring, neurology and neuroradiology services, and availability of neurosurgical and angiography services is recommended. Stroke intensive care units are expensive to run and do not reduce mortality – however, they may have a role for the aggressive management of carefully selected patients. Non-intensive stroke and rehabilitation units have been shown to reduce mortality, morbidity, institutionalisation, and even length of stay and healthcare costs. They facilitate better utilisation of resources, audit, teaching and clinical research. As the number of stroke patients in Singapore is expected to rise, with minor reorganisation, all Singapore hospitals should be able to establish their own stroke units.

Keywords: stroke unit, cerebrovascular disorders, review, intensive care unit, rehabilitation

INTRODUCTION

Cerebrovascular diseases are a leading cause of mortality and morbidity in Singapore. Stroke has remained the third leading cause of death in Singapore since 1970 (except 1995 when it was the fourth), accounting for 10% to 12% of all deaths annually, and a crude death rate of 50 to 60/100,000⁽¹⁾. Mortality rates may be different among the different races⁽²⁾. Fortunately, despite the ageing population, age-standardised rates have shown a steady decline in stroke mortality among both men and women in Singapore⁽³⁾. While there is no data on the true number of stroke patients in Singapore, there is evidence that the number of patients admitted to Singapore hospitals for stroke has been steadily rising over the years, to exceed 6,000 in 1994⁽⁴⁾. Stroke patterns in Singapore are different from the West – we see more lacunar infarcts and haemorrhagic strokes compared to Caucasian populations⁽⁵⁾.

The recent publication of trials and meta-analyses suggest that there are efficacious treatments for the

primary and secondary prevention and acute management of stroke⁽⁶⁻⁸⁾; these include anti-platelet agents^(9,10), anticoagulants^(10,11), neuroprotectants⁽¹²⁾, thrombolysis⁽¹³⁾, carotid endarterectomy⁽¹⁴⁾, aneurysm surgery⁽¹⁵⁾, to name a few. With continuing research and new clinical trials⁽¹⁶⁾, more treatments are likely to be found for patients with stroke in this “decade of the brain”. Interest has recently been revived in the role of stroke units in the management of stroke⁽¹⁷⁾. This paper reviews the available pertinent data on this issue, and suggests its applicability to stroke management in Singapore hospitals.

DEFINITION

While a number of definitions for the stroke unit have been used in the literature, they generally stem from two early descriptions:

“A team of specialists knowledgeable about the care of the stroke patient and who consult throughout the hospital wherever the patient may be, or a special area of a hospital that provides beds for stroke patients who are cared for by a team of specialists⁽¹⁸⁾”, and

“A geographical location within the hospital designated for stroke and stroke-like patients who are in need of rehabilitation services and the skilled professional care that such a unit can provide⁽¹⁹⁾”.

These definitions illustrate the 5 Ps of a stroke unit, where stroke patients are cared for in one place by professionals/specialists with the proper perspective/attitude.

Types of stroke units

From the definitions, with some overlap, Stroke Units are of 3 types:

1. Stroke Intensive Care Unit⁽²⁰⁾
2. Step-down Stroke Care Unit⁽²¹⁾
3. Stroke Rehabilitation Unit⁽²²⁾

Stroke Intensive Care Units (SICU)

SICUs are highly specialised intensive care units dedicated to the sole management of stroke patients. They are equipped with a small number of beds with facilities for ventilatory support, invasive and non-invasive continuous monitoring and advanced resuscitation for the aggressive management of stroke patients. They are staffed by highly trained nurses and therapists and are expensive to run. While they may

Department of Neurology
Tan Tock Seng Hospital
Moulmein Road
Singapore 308433

N Venketasubramanian, MBBS,
M Med (Int Med), FAMS
Consultant Neurologist

result in fewer complications from stroke, and may allow the earlier detection and treatment of these complications, they have not been shown to significantly reduce mortality or morbidity compared to patients managed in the general wards or community hospitals⁽²³⁻²⁹⁾. Their prohibitive cost combined with the lack of obvious benefit make SICUs an unattractive option for the routine management of the stroke patient. However, SICUs may have a role in the management of carefully selected cases (eg hypertensive-hypervolemic therapy for post-subarachnoid haemorrhage vasospasm) or post-operative monitoring where the stay can be expected to be short. SICUs would also have a role in providing the necessary environment for very acute stroke treatments such as thrombolysis, neuroprotection, hyperventilation, haemodilution and other novel treatments, especially in the setting of a clinical trial.

Effects on mortality

A number of trials have shown the beneficial effects of stroke units on mortality. A meta-analysis⁽³⁰⁾ was performed on 10 well-conducted randomised clinical trials where stroke patients were managed in a general medical or neurology ward, versus a stroke unit with a multidisciplinary team of specialists experienced in the care of stroke patients. The criteria for a stroke unit applied to a geographically defined stroke unit or a mobile stroke team (5 trials, 1,178 patients, stroke unit) or where comprehensive rehabilitation was given (5 trials, 408 patients, rehabilitation unit). Based on an intention-to-treat analysis, the primary outcome measured was mortality at 4 months and at 1 year.

At 17 weeks (median follow-up 13 weeks, range 5 to 17 weeks), odds of death was reduced by 28% in the stroke units, 27% in rehabilitation units, and 28% in the combined data (95% CI 0.56 – 0.95). This benefit was sustained at 1-year (median follow-up 12 months, range 6 to 12 months), with the odds of death reduced by 22% in the stroke units, 17% in the rehabilitation units, 21% in the combined data (95% CI 0.63 – 0.99). The rather wide confidence intervals for the rehabilitation units trials make the evidence for them less robust; the data for the stroke units is more compelling. A further analysis excluding trials with an informal randomisation procedure resulted in a 37% reduction in mortality among patients managed in stroke units. Mortality reduction was maintained in the sub-group analyses of patient management in stroke wards, stroke team, intensive rehabilitation and comprehensive rehabilitation. Subsequent extension⁽³¹⁾ of the meta-analysis to 12 trials with 2,177 patients corroborated the earlier findings – odds ratio(OR) for death at 12 months was 0.77 (95% CI 0.62 – 0.98).

The most recently published randomised trial⁽³²⁾ entered the largest number of patients in a single stroke unit trial to date (1,241 patients). It was a prospective community-based study of stroke patients entering 2 community hospitals, one with and one without a stroke unit. Patient populations were comparable. The protocolised stroke unit treatment

reduced in-hospital mortality with an OR of 0.50 (95% CI 0.34 – 0.74), case-fatality rate OR 0.45 (95% CI 0.28 – 0.71), 6-month mortality OR 0.57 (95% CI 0.39 – 0.82) and 1-year mortality OR 0.59 (95% CI 0.42 – 0.84).

Effects on morbidity

Apart from reducing mortality, stroke units have also been shown to reduce morbidity and improve functional outcome in some trials⁽³⁰⁾ – further comparison of the trials is difficult because of the inconsistent recording of outcomes among the different trials. Extension of the meta-analysis⁽³¹⁾ to 12 trials showed that poor outcomes defined as death or institutionalisation were seen in 343/1,019 stroke unit patients compared to 421/980 stroke patients in general wards, OR 0.67 (95% CI 0.56 – 0.80); the trends were similar in trials evaluating different types of care. Barthel index scores were significantly better among the stroke unit patients. In the large community-based study⁽³²⁾, the OR of being discharged to a nursing home was 0.61 (95% CI 0.38 – 0.98) and OR for being discharged home was 1.90 (95% CI 1.30 – 2.70) among stroke unit patients.

There was no evidence that morbidity was increased by improved survival in any of the trials⁽³⁰⁾.

Other benefits of stroke units

From the meta-analysis⁽³⁰⁾, it was found that more stroke unit patients had remedial therapy (physical, occupational and speech therapy) compared to controls. Stroke unit patients started therapy earlier than controls in some of the studies.

The large community-based study⁽³²⁾ also showed that there was a 30% reduction in the length of stay of stroke unit patients, with 1,313 bed-days saved per 100 stroke patients, and 3 nursing home places saved per 100 stroke patients. As length of stay was not prolonged, cost of the provision of in-patient health care was not significantly increased^(33,34).

From the perspective of the hospital administration, stroke units provide a means of placing patients together to maximise resources (eg nurses, therapists, medical equipment), and allow easier auditing of medical care and use of services.

Stroke units also allow data collection to provide information of the types of stroke patients seen in differing populations and the outcomes of management. They allow the performance of clinical trials and provide a rich source of clinical material for teaching and research.

Pan-European consensus meeting on stroke management

This Consensus meeting was held in Helsingborg, Sweden in late 1995, arranged by the WHO Regional Office for Europe and the European Stroke Council, in collaboration with the European Federation of Neurological Societies, International Stroke Society, World Confederation of Physical Therapy and World Federation of Occupational Therapists. It defined the most cost-effective strategies for stroke care organisation, management, rehabilitation and

secondary prevention of stroke in Europe. The following recommendations were made for stroke-units:

- a. The outcome for patients managed in a dedicated, non-intensive stroke unit or by a specialised stroke team has been shown to be superior to that of patients managed in general medical wards.
- b. Within each hospital, one single department should be responsible for managing stroke services.
- c. It is recommended that the care of patients with stroke should be undertaken in dedicated stroke units by trained teams of professionals.
- d. Systematic care plans and performance indicators should be used in these units.
- e. Until the benefits of intensive care stroke units have been evaluated, their use cannot be recommended, though certain patients may benefit from the high level of expertise offered by this type of facility.

One of the targets for all member countries in Europe for the year 2005 is that "all patients after acute stroke should have easy access to early specialised assessment and treatment from a stroke unit if available and continuing as long as benefit to the patient and family exists or is likely", and "rehabilitation services should be provided by an interdisciplinary team which is trained in stroke management". An Asia-Pacific Conference on Stroke Management was held in Melbourne in October 1997 (Singapore was a participant) that produced similar conclusions and recommendations.

Implications for care of stroke patients in Singapore

As the number of patients admitted to Singapore hospitals for stroke can be expected to rise, it is imperative that the intra- and extra-hospital services be organised to meet this challenge. Singapore is aptly served by 4 large public-sector hospitals – National University Hospital, New Changi Hospital, Singapore General Hospital and Tan Tock Seng Hospital – adequately covering the island. All these hospitals have neurological and general medical services. The establishment of non-invasive stroke units in all these hospitals (first established in Tan Tock Seng Hospital in 1992 and soon after in Singapore General Hospital) and the further set-up in the others should be encouraged, and requires only a minor reorganisation of services.

The Helsingborg declaration clearly spells out the requirements: while "the precise structure of the services should be adapted to meet local requirements", it still suggests that "an individual responsible for the co-ordination of stroke services should be identified in each geographical area or population served". It can be envisaged that each hospital would have a stroke unit co-ordinator, preferably a neurologist with specialised training in stroke management, supported by a multidisciplinary team (comprising nurses, therapists, social workers, dietitians, stroke educator), with patients cohorted to very few wards, with protocolised management care plans/care paths, with access to intensive rehabilitation if required. This system is already in place in Tan Tock

Seng Hospital, and the lessons learnt can be easily applied to all hospitals in Singapore.

CONCLUSION

The benefits of a stroke unit of reduced mortality, better functional outcome, shortened hospital stay, better co-ordination of resources, opportunities for teaching and research can be easily realised at little additional cost. This would complement the other advances in the management of what is presently Singapore's third biggest killer.

REFERENCES

1. Registry of Births and Deaths, Singapore. Annual reports. 1970 – 1995.
2. Venketasubramanian N. Inter-ethnic differences in cerebrovascular disease mortality in Singapore. *Cerebrovasc Dis* 1996; 6(Suppl 2):61.
3. Venketasubramanian N. Cerebrovascular disease mortality in Singapore. *Cerebrovasc Dis* 1995; 5:241.
4. Lim SH, Tan CH. Spectrum of neurological diseases in Singapore. *Neurol J Southeast Asia* 1996; 1:19-26.
5. Venketasubramanian N, Sadasivan B, Tan AKY. Stroke patterns in a Singapore hospital-based stroke data bank. *Cerebrovasc Dis* 1994; 4:250.
6. WHO Task Force on Stroke and Other Cerebrovascular Disorders. Recommendations on stroke prevention, diagnosis and therapy. Report of the WHO Task Force on Stroke and Other Cerebrovascular Disorders. *Stroke* 1989; 20:1407-31.
7. Adam HP, Brott TG, Crowell RM, Furlan AJ, Gomez CR, Grotta J, et al. Guidelines for the management of patients with acute ischemic stroke. A statement for health care professionals from a special writing group of the Stroke Council, American Heart Association. *Stroke* 1994; 25:1901-14.
8. The European Ad Hoc Consensus Group. European strategies for early intervention in stroke. A report of an ad hoc consensus group meeting. *Cerebrovasc Dis* 1996; 6:315-24.
9. Antiplatelet Trialists Collaboration. Collective overview of randomized trials of antiplatelet therapy. 1. Prevention of death, myocardial infarction, and stroke by prolonged antiplatelet therapy in various categories of patients. *Br Med J* 1994; 308:81-106.
10. Sherman DG, Dyken Jr ML, Gent M, Harrison MJG, Hart RG, Mohr JP. Antithrombotic therapy for cerebrovascular disorders. Fourth ACCP Consensus Conference on Antithrombotic Therapy. *Chest* 1995; 108(Suppl):444S-56S.
11. Atrial Fibrillation Investigators. Risk factors for stroke and efficacy of antithrombotic therapy in atrial fibrillation: analysis of pooled data from five randomized controlled trials. *Arch Int Med* 1994; 154:1449-57.
12. Gelmers HJ, Hennerici M. Effect of nimodipine on acute ischemic stroke. Pooled results from five randomized trials. *Stroke* 1990; 21(Suppl 4):IV81-4.
13. The NINDS rtPA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. *N Engl J Med* 1995; 333:1581-7.
14. Barnett HJ, Eliasziw M, Meldrum HE. Drugs and surgery in the prevention of ischemic stroke. *N Engl J Med* 1995; 332:238-48.
15. Meyer FB, Morita A, Puumala MR, Nichols DA. Medical and surgical management of intracranial aneurysms. *Mayo Clin Proc* 1995; 70:153-72.
16. Counsell C, Warlow C, Sandercock P, Fraser H, Van Gjin J. The Cochrane Collaboration Group. Meeting the need for systematic reviews in stroke care. *Stroke* 1995; 26:498-502.
17. Kalra L. Organization of stroke services: the role of stroke units. *Cerebrovasc Dis* 1996; 6:7-12.
18. Bonner CD. Stroke units in community hospitals. A "how-to" guide. *Geriatrics* 1973; 28:166-70.
19. McCann C, Culbertson RA. Comparison of two systems for stroke rehabilitation in a general hospital. *J Am Geriatr Soc* 1976; 24:211-6.

20. Wechsler LR, Ropper AH. Management of stroke in the intensive care unit. *Semin Neurol* 1986; 6:324-31.
21. Strand T, Asplund K, Eriksson S, Hagg E, Lithner F, Wester PO. A non-intensive stroke unit reduces disability and the need for long-term hospitalization. *Stroke* 1985; 16:29-34.
22. Garraway M. Stroke rehabilitation units; concepts, evaluation and unresolved issues. *Stroke* 1985; 16:178-81.
23. Kennedy FB, Pozen TJ, Gabelman EH. Stroke intensive care: an appraisal. *Am Heart J* 1970; 80:188-96.
24. Cooper SW, Olivet JA, Woolsey FM. Establishment and operation of combined intensive care unit for patients with cardiac and cerebrovascular disorders. *NY State J Med* 1972; 72:2215-20.
25. Pittner SE, Mance CJ. An evaluation of stroke intensive care units: results in a municipal hospital. *Stroke* 1973; 4:737-41.
26. Drake WE, Hamilton MJ, Carlsson M, Blumenkrantz J. Acute management and patient outcome: the value of neurovascular care units. *Stroke* 1973; 4:933-45.
27. Norris JW, Hachinski V. Intensive care management of stroke patients. *Stroke* 1976; 7:573-5.
28. Millikan CH. Stroke intensive care units. *Stroke* 1979; 10:235-7.
29. Erila T, Ilmavirta M. Does an intensive care stroke unit reduce early case fatality of ischemic stroke? *Stroke* 1990; 21(Suppl 1):153.
30. Langhorne P, Williams BO, Gilchrist W, Howie K. Do stroke units save lives? *Lancet* 1993; 342:395-8.
31. Stroke Unit Trialists Collaboration. Specialist stroke unit care improves survival and functional outcomes: a statistical overview. *Cerebrovasc Dis* 1994; 4:258.
32. Jorgensen HS, Nakayama H, Raaschou HO, Larsen K, Hubbe P, Olsen TS. The effect of a stroke unit: reductions in mortality, discharge rate to nursing home, length of hospital stay, and cost. A community-based study. *Stroke* 1995; 26:1178-82.
33. Holloway RG, Witter Jr DM, Lawton KB, Lipscomb J, Samsa G. Inpatient costs of specific cerebrovascular events at five academic medical centers. *Neurology* 1996; 46:854-60.
34. Bowen J, Yaste C. Effect of a stroke protocol on hospital costs of stroke patients. *Neurology* 1994; 44:1961-4.