

The King's College Hospital Acute Stroke Unit

ABSTRACT—The King's College Hospital (KCH) Acute Stroke Unit (ASU) was set up in January 1994 in order to provide acute management for patients admitted with stroke and to undertake biomedical research. Of 206 patients admitted to KCH with a stroke or suffering an in-hospital stroke, 141 (68%) patients were admitted to the ASU over its first 6 months of operation: 120 (85%) were from the Accident and Emergency Department and 21 (15%) from other wards. Management included resuscitation and medical stabilisation, investigation, prevention of stroke complications (including aspiration, venous thrombosis, and pressure sores), rehabilitation (physiotherapy, occupational therapy, speech and language therapy), nutrition (dietetics) and initiation of secondary prevention measures (aspirin or anticoagulation, blood pressure and lipid lowering, and carotid endarterectomy). All aspects of management are driven by agreed guidelines. Patients remain under the care of the admitting physician but specific stroke management and guidance is provided by two research doctors and the unit's nurses, therapists and dietician. The unit also facilitates research into stroke pathophysiology and acute therapeutic interventions. Our experience suggests that an ASU is relatively easy to set up and may contribute to improved care. Whether ASUs improve patient survival and functional outcome, and are cost-effective, requires further study.

Stroke rehabilitation units (SRUs) are gaining acceptance as a means of improving the management and rehabilitation of stroke patients [1,2]. An overview of randomised controlled trials comparing the outcome for patients admitted to SRUs with those admitted to general medical or geriatric wards found evidence that patients in SRUs have a significantly lower mortality [2]. Subsequent studies have suggested that length of stay and institutionalisation rates are reduced and functional outcome is improved in patients admitted to a SRU [3,4].

In contrast, the role of acute stroke units (ASUs or stroke intensive care units) is less well established [5-8]. Although admission to an ASU was associated with reduced thromboembolism, pneumonia, urinary tract

infection and pressure sore rates [5,7], there was no difference in mortality rates [9], perhaps because most preventable deaths occur after patients have left the ASU [10]. However, ASUs do appear to facilitate clinical research and in particular, clinical trials [11], much as coronary care units were central to the development of treatments (eg thrombolysis, aspirin) for acute myocardial infarction.

We felt it important to develop an ASU which would facilitate improvements in early stroke management and research. This paper describes how the unit was set up and its experiences during the first 6 months of operation.

Methods

Until the opening of the ASU, patients with acute stroke who required inpatient care were admitted to general medical or geriatric wards under the care of the on-call physician or geriatrician. It was generally accepted that this form of care was unsatisfactory and led to variable quality in nursing, rehabilitation, prevention of stroke complications and secondary stroke prevention.

Setting up the ASU

A proposal justifying the concept of an ASU was presented to the hospital's physicians, neurologists and management. Following widespread consultations, a decision was made to open an 8-bedded ASU at one end of a 'Nightingale' style ward. The number of beds was justified on the grounds that:

- One stroke patient is admitted to KCH each day (KCH Business Intelligence Unit)
- Patients should stay in the ASU for an average of one week to provide sufficient time for detailed investigations and to consolidate early treatment and rehabilitation. The beds would be transferred from the pool of medical beds and redesignated as stroke beds. Patients would remain under the care of the admitting physician but would be subject to certain management decisions made by the stroke team, particularly relating to therapeutic and rehabilitation regimens and enrolment into clinical studies.

A steering committee composed of three nurses (the medical senior nurse, ward sister and a senior registered nurse who would run the unit), three senior therapists (representing physiotherapy, occupational therapy, speech and language therapy), a dietician,

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and two doctors was set up. This committee met on five occasions to plan the lay-out of the ASU and develop the operational policy. The unit opened some four months after the initial suggestion to have an ASU.

No specific monies were allocated by KCH for opening the ASU; however, limited finance was obtained from the medicine care-group nursing budget and hospital 'Friends of King's' for purchasing monitoring and intravenous infusion equipment.

Patients

KCH (King's Healthcare NHS Trust) is a teaching hospital situated in a deprived inner area of south-east London and serves a local population of 220,000 (the former Camberwell District Health Authority). The stroke age-adjusted mortality is high (1.4 times that for England and Wales) reflecting, in part, a high incidence of stroke risk factors including hypertension, diabetes mellitus and atrial fibrillation. The hospital's Business Intelligence Unit suggested that some 400 patients per year were discharged from King's Healthcare with a diagnosis of stroke (ICD 9 codes 430-434 and 436-438).

The acute stroke unit

The ASU is an 8-bedded area separated from the main ward by rigid screens. One of the three ward nursing teams staffs the unit; this consists of 9 nurses (6 staff nurses, 3 auxiliary nurses, plus students when allocated) including the team leader. The unit takes all stroke admissions (but no other patients) directly from the Accident and Emergency Department and other wards and has no admission exclusion criteria, ie all patients with acute stroke are admitted. Direct referrals from general practitioners are not currently practised but may become desirable in the future to reduce stroke-admission delays. With an average admission rate of one stroke patient per day, patients stay in the unit for about one week. Patients are discharged on a first-in/first-out principle to their home, a medical or geriatric ward, or a general rehabilitation unit (a dedicated stroke rehabilitation unit is has recently opened).

Patients are managed by the admitting consultant physicians and their teams. However, a multi-disciplinary advisory ward round is held each day and involves two doctors, a ward sister or senior staff nurse, a physiotherapist, occupational therapist, speech and language therapist and dietician. Other members of the hospital staff attend weekly, including a member of the rehabilitation team. This round ensures that patients are managed according to an agreed set of management, investigational and therapeutic guidelines (Table 1). These guidelines were drawn up by a group of stroke-interested hospital personnel including a vascular physician, neurologist, neuroradiologist, vascular surgeon, therapists, dietician and non-clinical

Table 1. Acute stroke management guidelines (each is audited for compliance)

• Diagnosis of clinical syndrome (according to Bamford <i>et al</i> [12]).	
• Investigation of cerebral infarction (adapted from Donnan [13]).	
CT scan	all patients, repeat CT (MRI) after 7 days if normal
Carotid ultrasound	all hemispheric patients with reasonable recovery
Carotid angiography	if carotid ultrasound shows stenosis > 50%
Echocardiography	if previous or current heart disease.
• Young patients: thrombophilia and auto-antibody screens, inflammatory markers, syphilis.	
• Bilateral compression stockings to prevent deep vein thrombosis [14].	
• Treatment of non-haemorrhagic patients with aspirin (150mg) [15].	
• Dysphagic patients: early assessment by a speech and language therapist and dietician, intravenous fluids for two days, then nasogastric tube feeding for up to 12 days, then feeding percutaneous gastroenterostomy if further non-oral nutritional support required.	
• Treatment of hypertension from two days post-stroke, initially with bendrofluzide (1.25 mg or 2.5 mg od).	
• Treatment of patients with insulin-dependent diabetes mellitus with a sliding-scale insulin infusion.	
• Anticoagulation of non-haemorrhagic stroke patients with coexisting atrial fibrillation (heparin then warfarin) [16].	
• Referral of recovered patients with ipsilateral carotid stenosis (70-99%) for carotid endarterectomy [17,18].	
• Avoidance of urinary catheter except in some unconscious or non-compliant patients.	

scientists. The ASU attempts to ensure maximum communication between and within patients and staff [1].

Patients with a clinical diagnosis of subarachnoid haemorrhage have an immediate CT scan and are referred directly to the local neurosurgery unit; hence, they are not normally admitted to the ASU. Patients with primary intracerebral haemorrhage are also referred to the neurosurgical unit from the ASU if appropriate, eg cerebellar haemorrhage.

Audit and research

A stroke audit project was initiated in June 1993 to assess the implementation of stroke management guidelines. An audit officer collects demographic and management information on all patients which is stored on computer. Functional assessments (including Barthel, Rivermead and Rankin scores) are performed

by a therapist following admission and at 10 days and 3 months after the stroke.

Both pharmacological and pathophysiological research is undertaken in the ASU. Current trials include a local study of a novel vasodilating, anti-platelet and anti-leucocyte agent; the International Stroke Trial (IST), an international randomised controlled trial of aspirin and/or heparin; and a multi-centre trial of a neuroprotective agent. Pathophysiological research is orientated towards an understanding of the role of the megakaryocyte-platelet-haemostatic system and leucocytes in causing stroke.

Results

During the 6 months from 30 January to 31 July 1994, 206 patients were admitted to, or had a stroke in KCH. Of these, 141 patients (68%) were admitted to the ASU from the Accident and Emergency Department ($n = 120$, 85%) or other wards ($n = 21$, 15%). Most failures to admit patients to the ASU were due to difficulties in moving a patient off the unit to accommodate a new patient or a patient suffering a stroke in another ward in the hospital having been admitted for another reason. The demographic, clinical and management characteristics of the patients are given in Tables 2, 3 and 4. The modal length of stay was 8 days, mean 5.6 (Table 4).

Table 2. Admission characteristics for 141 patients admitted to the Acute Stroke Unit

Variable	<i>n</i>	%
Gender:		
Male	65	46
Female	76	54
Race:		
White	96	68
Black	41	29
Other	4	3
Source of admission:		
Home	125	89
Institution	15	11
In-hospital	1	< 1
Admitted via:		
A&E	120	85
Another ward	21	15
Stroke type:		
Cerebral infarction	104	74
Intracerebral haemorrhage	12	9
Subarachnoid haemorrhage	1	< 1
Transient ischaemic attack	4	3
Pseudo stroke	20	14
Discharged:		
Home	32	25
Ward	77	61
Other	1	< 1
Died	17	13
Potential trial inclusion:		
IST	80	57
MAST-I	7	5

Slightly more women were admitted, reflecting the greater proportion of women in the older population. A significant minority (29%) of patients was of black-African or black-Caribbean origin, which is considerably higher than the proportion of the local black population (18%). All but one patient were admitted from the local 'purchasing' area (Lambeth, Southwark and Lewisham Health Commission). Although most of the 121 patients admitted to the ASU had a stroke (86%), others had a 'pseudo' stroke; their final diagnoses included cerebral neoplasm, cerebral abscess, urinary tract infection, respiratory tract infection and overdose. Of the 121 patients with a confirmed stroke, 86% had a cerebral infarct, 10% a primary intracerebral haemorrhage and < 1% a subarachnoid haemorrhage.

Table 3. Risk factors for patients admitted to the Acute Stroke Unit

Numbers of patients with available data	Risk factor	<i>n</i>	%
	Hypertension		
140	Previous	79	56
140	Treated	64	46
126	On admission > 160/100	22	17
	Atrial fibrillation		
136	Previous	9	7
140	Warfarin	4	3
136	On admission	22	16
140	Diabetes mellitus	22	16
	Insulin dependent	6	4
	Non-insulin dependent	16	11
139	Smoking		
	Previous	53	38
	Current	31	22

Table 4. Admission characteristics for 141 patients admitted to the Acute Stroke Unit

Variable	<i>n</i>	Median (SQR)	Range
Age (years)	141	72 (10)	29-95
Delay, stroke to A&E (hours)	131	11.8 (10.6)	0.5-2151.9
Delay, A&E to ASU (hours)	109	8.0 (4.5)	0.6-27.9
Length of stay in ASU (days)	123	5.6 (2.1)	0-32
Admission blood pressure (mmHg)			
Systolic	126	150 (25)	95-240
Diastolic	126	90 (10)	50-160

Eighty per cent of the stroke patients had one or more stroke risk factors, including hypertension (past or current), diabetes mellitus, smoking or atrial fibrillation. Twenty-two patients (16%) had coexisting atrial fibrillation (AF) but only 9 of these were known to be in AF prior to admission.

Stroke trials vary in their inclusion criteria; the Multicentre Acute Stroke Trial-Italy (MAST-I) enrolled patients with cerebral infarction within 6 hours of stroke onset, while the IST includes patients up to 48 hours after the event. Five per cent of patients could potentially have been enrolled in MAST-I and 57% in IST. Enrolment of patients into studies such as MAST-I requires 24-hour CT scanning facilities which currently restricts our participation.

Discussion

Our experience with the ASU suggests that redesignating medical beds offers an easy, cost-effective and efficient way for setting up such a unit. The potential advantages of having an acute stroke unit include:

- Development of medical, nursing and therapist expertise in managing acute stroke patients
- Better prevention, detection and treatment of stroke complications (eg aspiration, chest infection, urinary tract infection, pressure sores, deep vein thrombosis and pulmonary embolism)
- Improved early management of stroke risk factors
- Training of junior medical staff
- Facilitation of clinical stroke research
- An increased understanding among members of the multidisciplinary team of each other's roles.

It is currently unclear whether admission to an ASU reduces mortality or disability; too few and only small randomised trials investigating ASUs and outcome have been performed and it is unlikely that further randomised trials of ASUs will be initiated since they are likely to be opened to facilitate drug intervention trials and patient management. Furthermore, if patients are moved to a SRU after 1–2 weeks, it is unlikely that improved management in the ASU could independently alter outcome because most acute deaths are not preventable (in the absence of proven acute therapeutic intervention). However, the ASU is likely to contribute positively to the total inpatient stroke process, consisting of both ASU and SRU, leading to an overall improvement in management and outcome. The mechanics by which stroke units reduce mortality [2], morbidity and length of stay [3,4] are unclear but probably relate to improvements in diagnosis, directed rehabilitation (treatment rather than just assessment), prevention of complications, early secondary prevention measures and increased staff expertise.

The ASU is run as a service within the Acute Medi-

cal Care Group at KCH and is not separately financed. No specific monies were identified for setting up the unit apart from the one-off purchase of monitoring and infusion equipment. Furthermore, no extra beds were required. The Senior Lecturer and Research Fellow contribute to the running of the unit and are funded through the associated medical school. Nursing, therapy and other staff are paid by the Trust and were provided from within existing establishment resources. Hence it is difficult to determine the precise economics of the unit. Furthermore, it is unclear whether inpatient stroke services are cost-effective but since most costs relate to staffing and hotel services [9], shorter inpatient lengths of stay, as occur within stroke units [3,4], will presumably lead to cost savings.

Although most patients were admitted with a stroke, a significant minority (14%) had other conditions presenting as an apparent stroke ('pseudo-stroke'); these included cerebral neoplasm, cerebral abscess, urinary tract infection and overdose. We are now trying to improve medical student and junior doctor training so that inappropriate admissions to the ASU are reduced through better diagnostic skill.

Our patient case-mix will reflect many inner urban areas but will be less representative of rural regions. The average age of patients admitted to the ASU was lower than expected (median 72 years). This cannot be explained by an age-related admission policy since the ASU attempts to admit all stroke patients, irrespective of age or clinical state. Nor is it due to the presence of other hospital units admitting stroke patients. The most likely explanation is that the high frequency of stroke risk factors (including hypertension, AF and diabetes mellitus) in a deprived local population leads to the premature development of cerebrovascular disease and stroke. Hence, 80% of patients had a history of, or presented with, one or more risk factors, including hypertension, atrial fibrillation, smoking or diabetes mellitus. The high incidence of hypertension partly reflects the high frequency of black patients (29%) who constitute only 18% of the local population; although 79 (56%) patients were known to be hypertensive, only 64 (46%) were taking anti-hypertensive medication. Similarly, atrial fibrillation was present in 22 (16%) patients but had only been diagnosed in 9 (41%), of whom only 4 were on warfarin. Clearly, community identification and treatment of risk factors needs to be improved.

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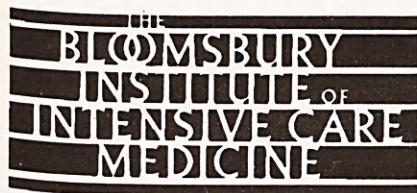
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