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Potential for quality improvement of acute stroke management in a district general hospital

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ABSTRACT

Background: Stroke units and thrombolysis are evidence based treatments for stroke patients. Few studies have prospectively assessed the success of, and obstacles to implementation of such strategies in patients admitted to district general hospitals.

Objective: To document delays in admissions of acute stroke patients to hospital, failures in accessing a stroke unit and the clinical impact of missed opportunities for intervention in acute stroke patients.

Design, setting and methods: Prospective observational study in a district general hospital in Northern Ireland. Delays, demographic details, risk factors, stroke severity and classification were recorded prospectively in all stroke patients admitted to a district general hospital from 22 March 2004 until 21 March 2005. Using established numbers needed to treat to prevent disability or death, the clinical impact of the lost opportunities was determined.

Results: Of 171 acute stroke patients 115 (67%) spent some or all of their hospital stay in a stroke unit. Less severe strokes, living alone and attending a general practitioner all independently delayed hospital admission. Nineteen (12.5%) ischaemic stroke patients would have been eligible for intravenous thrombolysis treatment. Admitting all patients to the stroke unit would have gained independence for two patients, allowed two more patients to live at home, and prevented one death. Failure to thrombolysed eligible acute ischaemic stroke patients resulted in six patients having more disability, two of whom may have lost their independence.

Conclusions: Improved stroke unit access is required in this district general hospital. Reorganisation of acute stroke services should allow thrombolysis for acute ischaemic stroke in most district general hospitals.

Intravenous thrombolysis¹ and acute stroke units² improve stroke outcome. Previous studies of factors associated with delayed presentation have frequently combined data from a number of hospitals.^{3,4} Few studies have focused on an individual hospital, and in particular a district general hospital,⁵ where the majority of stroke patients are managed. Individual hospitals in the UK have been able to compare their stroke management and rehabilitation performance with the help of stroke audits⁴; however, these studies have often been small, retrospective, and have sampled case management in an unblinded manner. Detailed prospective studies are required as there is evidence from selected institutions with different healthcare systems of better outcomes from acute ischaemic stroke than from the UK and Ireland, even after adjusting for case mix and healthcare system.⁶

In this study we examined which factors predicted late admission to hospital. We also measured the eligibility rate for thrombolysis in acute ischaemic stroke. Using recognised numbers needed to treat for disability and death we sought to model the net effect of improving an acute stroke service in two specific management areas: firstly, from potential thrombolytic treatment for acute ischaemic stroke; and secondly, from the use of an acute stroke unit for all stroke patients admitted to our district general hospital over a 12 month period.

METHODS

Patient recruitment

The study was performed in a district general hospital serving a population of approximately 170 000. The hospital has a 12 bed stroke unit to look after acute ischaemic and haemorrhagic stroke patients. Intravenous thrombolysis for acute ischaemic stroke was not available during the period of the study. Consecutive patients admitted to the hospital were eligible for study if they had a clinical diagnosis of acute stroke (a sudden neurological deficit lasting longer than 24 h attributed to a vascular cause) and had compatible neuroimaging to differentiate intracerebral haemorrhage from acute ischaemic infarction. Patients were over 18 years of age. Patients with intracerebral haemorrhage due to trauma, tumour, arteriovenous malformation, aneurysmal subarachnoid haemorrhage, or extradural and subdural haemorrhage were excluded.

Prospective data on acute stroke patients were collected from 22 March 2004 until 21 March 2005. Delays in admission to hospital, neuroimaging and admission to the acute stroke unit were recorded. Demographic features, clinical risk factors, circumstances at stroke onset (awakening with symptoms and living alone), Oxfordshire Community Stroke Project classification and stroke severity as measured by the National Institute of Health Stroke Scale (NIHSS) were recorded. Eligibility criteria for intravenous thrombolytic therapy were adapted from the National Institute of Neurological Disorders and Stroke (NINDS) study group¹: patients arriving at or before 2.5 h of symptom onset (to allow 30 min to complete clinical and diagnostic studies and start treatment), NIHSS >4, normal coagulation, platelet count over 100 000/mm³, no history of ischaemic stroke within 3 months, no history of brain tumour or intracranial haemorrhage, no seizure at symptom onset, systolic blood pressure <180 mm Hg and diastolic blood pressure <110 mm Hg, and no major surgery at a non-compressible site within 30 days.

Outcome measures

Demographic and stroke details were compared between patients with acute ischaemic stroke and patients with intracerebral haemorrhage, and between early (admitted at or within 2.5 h) acute ischaemic stroke patients and ischaemic stroke patients admitted after 2.5 h. The number of ischaemic stroke patients who were deemed eligible for intravenous thrombolysis treatment during the study was determined. The clinical impact of this potential treatment was estimated from the recognised numbers needed to treat (NNT) for thrombolysis treatment.⁷ In the second part of the study the number of stroke (ischaemic stroke and intracerebral haemorrhage) patients excluded from the stroke unit over the year was determined. The potential clinical impact from the lack of stroke unit care was estimated from the NNT for stroke unit care.²

Statistical analyses

Median values with interquartile ranges were reported for NIHSS values because of the skewed distribution of these data. Categorical data were compared using χ^2 tests, ordinal data with the Mann-Whitney U test, and continuous data with Student's t test. Kaplan-Meier plots were used to show delay times. Univariable analyses (age, sex, stroke type, stroke severity using the NIHSS, ambulance transport, pre-hospital assessment by a general practitioner (GP), living alone and stroke outside the city limits) were compared for the outcome measures. For hospital delays dichotomised at 2.5 h from ischaemic stroke onset, multiple logistic regression was used to determine the independent effects of the factors examined in the univariable analyses, with each factor being mutually adjusted for each other in the multivariable models.

RESULTS

The study sample comprised 171 patients: 96 men, 75 women, mean (SD) age 69.9 (12.7) years. The baseline demographic and stroke details are shown in table 1. Patients with intracerebral

Table 1 Baseline demographic and stroke characteristics of patients admitted with acute ischaemic and haemorrhagic stroke

	Ischaemic stroke	Intracerebral haemorrhage	p Value
Number	152	19	
Mean age (SD) (t test)	70.3 (12.5)	67.4 (13.9)	0.35
Male sex, n (%)	82 (54.0)	14 (73.7)	0.10
Ischaemic heart disease, n (%)	50 (33.0)	6 (31.6)	0.91
Hypertension, n (%)	86 (56.6)	7 (36.8)	0.1
Diabetes, n (%)	28 (18.4)	2 (10.5)	0.39
Cigarette smoking, n (%)	49 (32.2)	4 (21.0)	0.32
Atrial fibrillation, n (%)	45 (29.6)	3 (15.8)	0.25
Wakened with stroke, n (%)	41 (27.2)	4 (21.0)	0.66
Lived alone, n (%)	55 (36.7)	6 (31.6)	0.66
Seen by GP, n (%)	78 (51.3)	5 (26.3)	0.04
Ambulance transport, n (%)	71 (48.6)	12 (63.2)	0.15
Stroke in city, n (%)	84 (55.3)	11 (57.9)	0.83
Median NIHSS (IQR)	4 (6.5)	8 (12)	0.006
TACS, n (%)	12 (7.9)	4 (21.0)	0.063
PACS, n (%)	49 (32.2)	7 (36.8)	0.95
LACS, n (%)	67 (44.1)	3 (15.8)	0.018
POCS, n (%)	24 (15.8)	5 (26.3)	0.25

GP, general practitioner; IQR, interquartile range; LACS, lacunar circulation syndrome; PACS, partial anterior circulation syndrome; NIHSS, National Institute of Health stroke score; POCS, posterior circulation syndrome; TACS, total anterior circulation syndrome.

Figure 1 Delays to hospital admission in ischaemic and haemorrhagic stroke patients following recognition of stroke.

haemorrhages (n = 19) had more severe strokes than patients with ischaemic strokes (n = 152), median NIHSS 8 versus 4 (p = 0.006), and were less likely to have been seen by a GP before admission (p = 0.04). Lacunar syndromes were more frequent in the ischaemic stroke group compared to the intracerebral haemorrhage group (p = 0.018). Figure 1 shows the delays to hospital admission for ischaemic and haemorrhagic

Figure 2 (A) In-hospital delays for neuroimaging of acute stroke patients. (B) Delay in admission to acute stroke unit (ASU) following hospital admission.

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Figure 3 Flow chart of arrival in hospital at or within 2.5 h and eligibility for intravenous thrombolytic in acute ischaemic stroke patients.

stroke patients. Patients with haemorrhagic stroke had shorter delays to hospital admission than patients with ischaemic stroke (log rank test, $p = 0.066$; Wilcoxon $p = 0.033$). There were 10 patients who had in-hospital strokes.

Figure 2A details the in-hospital delays in all stroke patients for neuroimaging (computed tomography in the majority of patients). Just over 50% were scanned within 48 h of admission. One hundred and fifteen patients (67%) were admitted to the stroke unit at some time during their hospital stay. Figure 2B documents the delays in admission to the stroke unit of these 115 patients following arrival in hospital. Approximately half of these patients reached the stroke unit within 48 h of their arrival in hospital, but the remainder had even longer stroke unit admission delays often because non-stroke patients were in the stroke unit.

Of the 152 patients admitted with acute ischaemic stroke, only 48 (32%) arrived in hospital at or within 2.5 h of symptom onset and had not wakened with symptoms. Figure 3 shows

Table 2 Association between variable and likelihood of being admitted to hospital within 2.5 h after having an ischaemic stroke

Variable	Crude OR (95% CI)	P value	Adjusted* OR (95% CI)*	p Value
Age	1.00 (0.97 to 1.02)	0.81	0.98 (0.95 to 1.02)	0.40
Sex	1.58 (0.80 to 3.16)	0.19	1.03 (0.43 to 2.48)	0.94
NIHSS	1.10 (1.04 to 1.17)	<0.001	1.09 (1.01 to 1.17)	0.02
Ambulance	1.26 (0.63 to 2.51)	0.52	0.87 (0.36 to 2.08)	0.75
Seen by GP	0.12 (0.05 to 0.27)	<0.001	0.09 (0.04 to 0.25)	<0.001
Lived alone	0.54 (0.26 to 1.15)	0.11	0.25 (0.10 to 0.66)	0.01
Stroke in city	1.51 (0.75 to 3.05)	0.25	0.99 (0.41 to 2.38)	0.99

CI, confidence interval; GP, general practitioner; NIHSS, National Institute of Health Stroke Score; OR, odds ratio.

*All variables mutually adjusted for each other.

that just 19 of these patients (12.5%) were eligible for intravenous thrombolytic treatment (NIHSS >4 and no other NINDS exclusion criteria). Applying the stricter SITS-MOST criteria (which also excluded patients with severe stroke with NIHSS >25 and patients with any history of prior stroke and concomitant diabetes)⁸ did not alter this result. All eligible patients had been previously independent. A greater proportion (11 of 19, 58%) of intracerebral haemorrhage patients were admitted within 2.5 h of stroke onset. Table 2 compares features of acute ischaemic stroke patients who presented at or within 2.5 h of stroke onset with the features in patients presenting later. Univariable analyses showed that lower NIHSS and being seen by a GP before admission were associated with a delay in admission of more than 2.5 h following stroke recognition, with weaker evidence for a similar association in patients who lived alone. In addition, there was evidence that ischaemic stroke patients who were seen by a GP had less severe strokes (median NIHSS = 6 among 74 patients not seen by a GP compared to median NIHSS = 3 among 78 ischaemic stroke patients seen by a GP; median test: $p = 0.001$). In a multiple logistic regression model for the 2.5 h time limit all three variables (stroke severity, being seen by a GP, and living alone) independently predicted delays in admission to hospital.

Table 3 shows the clinical impact of failing to treat eligible acute ischaemic stroke patients with intravenous thrombolysis treatment and failing to admit all stroke patients to the stroke unit. Although some patients had a delayed admission to the stroke unit, only those patients who were not admitted to the stroke unit at any stage throughout their hospital stay were used to calculate the number not treated in the stroke unit. When the NNT estimation is applied across a full spectrum of non-binary outcomes, intravenous thrombolysis may have improved final outcome in six patients in the current cohort,⁷ two of whom lost their independence.

DISCUSSION

This study has demonstrated shortfalls in different aspects of an acute stroke care service in a district general hospital. Thrombolysis rates remain very low in the UK except in dedicated stroke centres,⁹ which are usually based in teaching hospitals.¹⁰ Most patients with an acute stroke are admitted to a district general hospital, but continue to experience difficulty accessing the facilities of an acute stroke unit for part or all of their stay in hospital.^{9–11} This can be particularly difficult in district general hospitals, which may have more staff resourcing difficulties than teaching hospitals. Although not directly assessed in this study, neuroimaging delays resulted because there was no hospital policy to scan immediately on admission. Instead scans were often postponed until daytime lists allowed. Stroke unit admissions were prevented mostly because non-stroke patients occupied the beds (as there was no hospital

Table 3 Clinical impact of patients not treated

Treatment	Number needed to treat for benefit	Number not treated	Clinical impact (number who lost benefit)
Intravenous thrombolysis		19	
Excellent outcome	8.4		2.3
Reduced disability	3.1		6.1
Stroke unit		53	
Death	33		1.6
Alive at home	20		2.6
Independent	20		2.6

policy for ring-fencing any of the stroke unit beds) and to a lesser extent because of discharge delays. The impact of potential improvements in our district general hospital are somewhat similar for thrombolytic therapy and stroke unit access, assuming that eligible acute ischaemic stroke patients can in fact be treated with thrombolytic therapy in real practice. A stroke monitoring study has confirmed that thrombolysis in suitable acute ischaemic stroke patients is safe in routine clinical practice,¹² even in rural settings¹³ and in inexperienced units.¹⁴ Many authorities agree that reorganisation of stroke services, particularly for acute stroke care, is required to improve outcome.¹⁵

Delay in presentation continues to be the most common reason why patients are ineligible for thrombolytic therapy,¹⁶ although there is clearly potential for improving intrahospital coordination of stroke management.¹⁷ Like other studies, we have demonstrated that increasing stroke severity reduces delay in hospital admissions.^{18–19} However, it is important to realise that if time is removed as an exclusion criterion for thrombolytic therapy, less than one third of all ischaemic stroke patients are eligible for recombinant tissue plasminogen activator (rt-PA) treatment.²⁰ This is because other factors such as mild stroke severity, medical and surgical history and seizure at onset exclude many ischaemic stroke patients. In the USA, primary stroke centre recommendations²¹ have been associated with increased thrombolysis rates,²² helping to make acute thrombolytic therapy an integral part of an acute stroke unit's activity. In our study, in addition to less severe stroke, attending a GP and living alone were independent predictors of delayed hospital admissions. Public education measures to change patients' behaviour following stroke-like symptoms may decrease delays in hospital admissions. Unfortunately such measures have not always been effective,¹⁸ but when aggressively targeted thrombolytic treatment rates can improve.²³ Although also outside the scope of our study, coordinated stroke ambulances²⁴ offer another type of tailored improvement programme to decrease admission delays.

A phase 3 study of recombinant factor VIIa for intracerebral haemorrhage (FAST – Factor seven for Acute haemorrhagic Stroke Treatment) completed in November 2006 showed no reduction in disability or death despite a promising phase 2 study.²⁵ In our study a greater proportion of intracerebral haemorrhage patients arrived within 3 h (presumably due to more severe neurological deficits) compared to the proportion of acute ischaemic stroke patients within this time window, suggesting that any future time-limited acute medical management of intracerebral haemorrhage may be applicable to a greater proportion of patients, but the absolute numbers would be relatively small in a district general hospital. We were able to draw this conclusion because we used similar exclusion criteria to the FAST study (that is, patients with secondary causes of intracerebral haemorrhage were not recruited).

The size limitation of our study accurately reflects an important issue in managing acute stroke patients in a district general hospital. The prospective nature of our study with simultaneous analyses of delays, thrombolysis eligibility rate, access to neuroimaging and to a stroke unit reflects real practice for patients and stroke physicians. As not all changes in a healthcare system represent healthcare improvements for patients,²⁶ it is now recognised that quality improvement requires better development and delivery of care to achieve

better health outcomes.²⁷ Our study highlights the feasibility of the necessary measures to achieve such an improvement in acute stroke management in a district general hospital.

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