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CT Scanning in Stroke Patients: Meeting the Challenge in the Remote and Rural District General Hospital

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Abstract

Introduction

National audit data allow crude comparison between centres and indicate that most Scottish hospitals fail to meet current guidelines for CT scanning of the brain in stroke patients. This study identifies some of the reasons for delay in performing CT scans in a largely rural population.

Methods

This audit study assesses the delays from onset of symptoms, time of admission and request received to CT scan in stroke patients for three different in-patient groups as well as those managed in the community.

Results

The reasons for delay in CT scanning varied between different patient groups but for one group of in-patients, changes in booking procedure and introduction of a second CT scanner increased the proportion scanned within 48 hours of request from 65% to 96%.

Discussion

Further developments including the introduction of Saturday and Sunday routine CT scanning, radiologist reporting from home and additional CT scanners placed in remote hospitals may be expected to improve these figures further. Target times of three hours from onset of symptoms to scan to allow thrombolysis may however be impossible to meet for all stroke patients in rural areas.

Introduction

NHS expenditure on stroke care exceeds £2.8 billion per annum.[1] Brain imaging by Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) is required to distinguish ischaemic from haemorrhagic stroke and allow early thrombolytic or anti-platelet therapy.

Wardlaw et al[2] demonstrated that performing a CT brain scan immediately in patients with suspected stroke is most effective and reduces overall costs (£9,994 vs. £10,220 per patient) compared to scanning at 48 hours. Savings from reduced length of stay and improved outcome exceed the extra costs of scanning some patients at night or on an emergency basis.

National guidelines for England and Wales in 2004 advocated brain imaging within 24 hours of onset of symptoms (ictus).[3] This target was, however, achieved in only 42% of patients in 2006 in England and Wales.[4]

Scottish guidelines in 1997 recommended that all acute stroke patients should have brain imaging preferably within 48 hours of admission[5] but by 2004 only one third of hospitals met the 48 hour target in 80% of their patients.[6]

The Highland region covers one third of the land area of Scotland but with only four per cent of the population mostly within remote and small rural communities. Inverness is the largest centre of population (60,000) and is served by Raigmore Hospital. In 2004, only 48% of Raigmore Hospital stroke patients underwent brain CT within 48 hours of admission.[6]

The option of thrombolysis is restricted to those patients who can be admitted, assessed and undergo CT scanning within three to four hours of ictus. This has proved difficult to achieve even in major centres[7] and in 2006 only eight per cent of hospitals in England and Wales could offer this service.[4]

This study aimed to evaluate access to CT, and identify reasons for delay to scan. Following changes in scan booking procedure a short follow-up study was performed.

Method

Raigmore Hospital in Inverness is a 577 bed district general hospital serving as a tertiary referral centre for most specialties. In 2004, 4200 CT examinations were performed on a single slice helical CT scanner including 1077 in-patient head scans.

Stroke patients from Wick in Caithness and Sutherland are referred to Raigmore Hospital, as there is no CT facility north of Inverness. This necessitates a 220 mile journey usually taking seven to eight hours for the return journey.

The hospital in Fort William is 70 miles from Inverness serving a large and remote area with relatively small population. Its CT scanner performs approximately 500 examinations per year.

Images are acquired by local radiographic staff to agreed protocols and interpreted on a workstation in Raigmore Hospital.

Scan priority is routinely given to cases in need of urgent imaging as identified by attending medical staff, usually on the basis of history, medication, presentation or rapid deterioration. In 2004, requests for CT scans were made by delivery of a handwritten or faxed card to the main department office or CT control room.

Between 2004 and 2006, acute medical unit nursing staff, physicians and radiographers were involved in discussions to reduce delays in organising CT scans. Measures introduced included allowing ward nursing staff to request scans, booking by telephone directly with radiographers in working hours, speedier delivery of request cards from ward to the main office and immediate transmission from there to the CT department. A second Raigmore CT scanner was installed in 2006.

This audit included all patients presenting for CT scan of brain in Highland region with suspected acute stroke or transient ischemic attack (TIA) over a 10 week study period in Raigmore Hospital during 2004. Data were collected over a 54 week period in Fort William in view of the smaller population served.

A small number of patients had MR brain scans following the CT, but MR was not used as the primary imaging examination for acute stroke patients.

A limited follow up study of Raigmore Hospital in-patients was made in 2006 over four weeks to assess the impact of the described changes.

Dates and times of ictus and admission to Raigmore Hospital were obtained by case note review and in Fort William by radiographic staff at the time of scanning. Timings of card delivery, faxes, telephoned requests and of CT scan were recorded by clerical and radiographic staff in both centres.

For each group of patients in each locality delay from ictus to CT scan, delay from admission to CT scan for in-patients and delay from receipt of request to CT scan were analysed.

Results

Raigmore 2004

During the study period in 2004, 72 patients with suspected stroke underwent brain CT scanning in Raigmore (Table I), 27% were scanned within 48 hours of ictus (18/67) and 34% were scanned within the target time of 48 hours from admission (19/56). Six were already in-patients at the time of the acute event. For the 55 Raigmore in-patients, timing of ictus was available on 51 with 35% of these scanned within 48 hours (Table II). Admission time was available for 46 patients with 41% of these undergoing brain CT scanning within 48 hours of the time of admission.

Table I: Performance of CT Scanning in Stroke Patients by Centre in 2004.

		CT scan performance by time to scan		
	n	< 48 hrs n (%)	48 hrs - 7 days n (%)	> 7 days n (%)
Symptoms - scan *				
All patients at Raigmore	67	18 (27)	32 (48)	17 (25)
Fort William patients	39	22 (56)	17 (44)	0
Admission - scan				
All patients at Raigmore**	56	19 (34)	31 (53)	6 (11)
Fort William patients	44	40 (91)	4 (9)	0
Request - scan				
All patients at Raigmore	72	38 (53)	29 (40)	5 (7)
Fort William patients ***	43	43 (100)	0	0

Table II: Performance of CT Scanning at Raigmore Hospital by Origin of Patients.

		CT scan performance by time		
	n	< 48 hrs n (%)	48 hrs - 7 days n (%)	> 7 days n (%)
Symptoms - scan *				
Raigmore In-patients 2004	51	18 (35)	24 (47)	9 (18)
Caithness 2004	10	0	6 (60)	4 (40)
GP 2004	6	0	2 (33)	4 (66)
Raigmore In-patients 2006 **	24	12 (50)	10 (42)	2 (8)
Admission - scan				
Raigmore In-patients 2004	46	19 (41)	24 (52)	3 (7)
Caithness 2004	10	0	7	3 (30)
GP 2004				
Raigmore In-patients 2006 **	24	18 (75)	6 (25)	0
Request - scan				
Raigmore In-patients 2004	55	36 (65)	19 (35)	0
Caithness 2004	10	2 (20)	5 (50)	3 (30)
GP 2004	7	0	5 (71)	2 (29)
Raigmore In-patients 2006	25	24 (96)	1 (4)	0

* Time of onset not available for four Raigmore and one GP patient in 2004
** Time of onset and time of admission not available for one patient in 2006

From the time of receipt of a request card in the department 65% were scanned within 48 hours (36/55). Times of admission to the ward were available on 42 patients showing that eight were admitted between midnight and midday with 16 entering the ward between 1200 and 1700 and 18 arriving after 1700 hours. The average time to brain imaging showed little difference between these groups and much variation within it.

Most request cards received by the department office were passed on to the CT staff within three hours (30/42) but it was found that even this delay may cause a patient to miss a late afternoon scan opportunity. Delivery of ten request cards to the appropriate staff was delayed overnight and two for greater than 24 hours. Most requests received after 1400 hours were effectively too late to allow routine scheduling of the scan on the same day. For eight patients this delay extended from Friday until Monday or later.

None of the Caithness and Sutherland patients could be scanned within 48 hours of symptoms or admission and only 70% (7/10) were scanned within seven days of admission (Table II). Following receipt of the request by faxed card two patients were booked to be scanned within 48 hours and all ten patients received an appointment within seven days of request. However, three patients were too ill to travel and had their appointment postponed at the request of the referring medical staff.

A total of seven referrals were received directly from GPs between two and 14 days after onset of symptoms. Unsurprisingly the scan could not be performed on any of these patients within 48 hours and only one third (2/6) underwent CT scanning within seven days of symptoms starting. Five patients were scanned within seven days of receipt of the card and the remaining two within the next 24 hours. These patients travelled between six and 100 miles for the service (mean 32 miles).

Fort William 2004

56% of patients in Fort William were scanned within 48 hours of ictus (22/39) and 100% within seven days (Table I). 91% were scanned within 48 hours of admission (40/44) and 100% within 48 hours of the card being received by the CT department.

Reported findings from the CT scans in both centres in 2004 were available on 111 patients. Sixty had evidence of cerebral infarction, 32 were normal, nine had cerebral haemorrhage, six had periventricular lucency or atrophy, two had subarachnoid bleeds, one had a subdural collection and one had tumour

Raigmore in-patients 2006

After implementation of the changes described above, delays had been reduced so that in 2006, 50% of stroke patients had CT scan within 48 hours of ictus, 75% within 48 hours of admission and 96% were scanned within 48 hours (24/25) of request (all but 4 patients were scanned within 6 hours of notification), (Table II).

Discussion

The reasons for delay to CT brain scan after onset of symptoms of stroke are multiple: the interval between onset of symptoms and alerting medical staff or emergency services together with the delay in transporting the patient to a centre with a CT facility constitutes the ictus to admission delay. This was found to be approximately six hours (range three hours to three days) for most Raigmore patients in 2006 compared to 78 minutes as described by Grond[8] within the 156 square miles of the city of Cologne.

There are additional delays in identifying which patients should undergo imaging, in transmitting a request to the CT scanning staff, and in performing the scan due to pressure of work and resistance to opening access overnight and during weekends

There is a marked contrast between the service offered to patients in the two particularly remote areas in our study: Caithness & Sutherland, and Fort William. The latter benefits from a relatively underused CT scanner that was funded by charitable donation and would not have been supported otherwise at the time of its installation. Cost per case was approximately £186 in 2004 (one of the highest in Scotland) but allowed Fort William to meet the stroke guidelines in 2005 for CT scanning and aspirin therapy after stroke (the only Scottish hospital to do so).[9]

Restricted availability of transport for patients from remote areas such as Caithness and Sutherland outwith 0900 to 1700 hours limits the opportunity for urgent scanning. Some of these patients had examinations delayed or cancelled if they could not be scanned around midday or if they were not fit to travel.

It has not been the practice in Raigmore hospital to provide a non emergency CT scanning service overnight or on Saturdays and Sundays. Patients whose requests were received after Friday midday were unlikely to have a CT scan until Monday with the result that eight out of the 55 patients had scans delayed by three days over the weekend.

Our data show that changes in procedure together with the installation of a second Raigmore CT scanner produced considerable improvement in the proportion of in-patients scanned within 48 hours of request from 65% in 2004 to 96% in 2006. Delay in admission and delay in requesting the scan still prevented 50% of the total cohort of patients being scanned within 48 hours of ictus. Automatic generation of a request by patient admission was considered but not implemented in order to comply with radiation protection legislation. Routine weekend scanning for stroke has not yet been introduced but will be necessary if current target times are to be met for all patients. Electronic requesting would bypass some of the logistical delays and could ensure that relevant information is available. It would also allow scheduling of examinations specifically to meet target times.

24 hour immediate radiologist reporting could be facilitated by broadband links to radiologists' homes – estimated to cost £2,000 for this department in 2004.

A local CT facility in Wick may be expected to transform delay to imaging times for Caithness and Sutherland patients to those observed in Fort William. With the relatively small numbers involved such a facility is expected to be as expensive on a cost per case basis as the service in Fort William and has not yet been funded.

Delays from ictus to admission are more difficult to influence and meeting the requirements for thrombolysis will require a radical alteration of public perception and the need for urgent admission.[10] No less change is required within the medical profession dealing with suspected stroke patients in order to reduce or bypass GP attendance times, streamline transfer to an imaging centre and obtain an interpreted scan within this tight time frame. Given that journey times of two to three hours from home to hospital in this region are not uncommon the possibility of thrombolysis may in fact be unachievable for many in remote and rural areas.

Admission to scan time data collected at the point of scan for Raigmore in-patients (41% within 48 hours) are similar to data

collected for national audit statistics (48%). However patients from Caithness and the community are particularly disadvantaged by geographical location, delayed referral and competing for access on a busy scanner.

The collection of data for this audit by radiographic staff and their involvement in discussions stimulated the changes in procedure and a desire to meet target times

The small number of patients and incomplete data availability should be acknowledged but we feel the data are sufficient to draw firm conclusions.

Conclusion

Failure to meet national guidelines for brain imaging of acute stroke patients is due to delays at several stages of the patient pathway. This study demonstrates that the differences in time from onset of symptoms of stroke to having a CT scan of brain depend on distance from home to CT scanner, CT scan workload, availability of CT scanner and staff, and the method of requesting a CT scan. Some of these delays are irremediable but other delays can be reduced given adequate resources and change in practice.

Contributors

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References

1 Reducing Brain Damage; faster access to better stroke care. 2005 National Audit Office, The Stationary Office, London. www.nao.org.uk/publications

2 Wardlaw JM, Seymour J, Cairns J, et al. Immediate computed tomography scanning of acute stroke is cost effective and improves quality of life. Stroke 2004;35;2477

3 National Clinical Guidelines for Stroke, Intercollegiate Stroke Working Party 2004. Royal College Physicians, London

4 National Sentinel Stroke Audit 2006. Clinical Effectiveness and Evaluation Unit, Intercollegiate Stroke Working Party, Royal College Physicians, London. www.rcplondon.ac.uk/pubs/books/strokeaudit/strokeaudit2006

5 Management of Patients with Stroke. Scottish Intercollegiate Guidelines Network 1997. www.sign.ac.uk/pdf/sign13.pdf

6 National Report on Stroke Services in Scottish Hospitals 2004/5. Scottish Stroke Care Audit, NHS Scotland. www.strokeaudit.scot.nhs.uk

7 Warlow C, Wardlaw J. Therapeutic thrombolysis for acute ischaemic stroke. BMJ 2003;326:233-234

8 Grond M, Stenzel C, Schmulling S, et al. Early intravenous thrombolysis for acute ischaemic stroke in a community based approach. Stroke 1998;29;1544-1549

9 Stroke Services: Care of the patient in the acute setting. NHS Quality improvement in Scotland 2005. www.nhshealthquality.org

10 Jenkinson D, Ford G.A. Research and development in stroke services. BMJ 2006;332;318