Time from Hospital Admission to CT Brain in Acute Ischaemic Stroke

Abstract:

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Abstract
A retrospective study of all acute ischaemic stroke patients admitted to Midland Regional Hospital Mullingar (MRHM) between January 2004 and September 2009 was undertaken in order to assess the median time from hospital admission to CT brain scan (n=496). The median time to CT scan ranged from 19-24 hours between 2004-7. In 2008, coinciding with setting up a new Acute Stroke Service (ACSS), the median time to CT scan dropped to 15 hours (n=130, p=0.03) and decreased further to 3 hours in 2009 (n=125, p=0.003). The proportion scanned within 1 hour of admission increased from 7 patients (4.6%) over 2004-7, to 28 patients (21.5%) in 2008 (p = 0) and 44 patients (35%) in 2009 (p = 0.018). This clinically and statistically significant reduction occurred following reorganisation of existing resources on a budget neutral basis at MRHM and was facilitated by the enthusiastic support of a range of disciplines bridging the community and acute hospital interface. Measurement of admission to CT brain scan time is one of several audit parameters which can assess hospitals responsiveness to acute stroke.

Introduction
In 2002, the World Health Organisation estimated over 15 million people suffered an acute stroke resulting in over 5 million deaths, accounting for 10% of deaths globally. [1] By 2030, this will rise to an estimated 23 million first-ever strokes globally resulting in 7.8 million deaths. [2] Stroke is the leading cause of acquired neurological disability in the community, with substantial after effects on patients and their families and associated high health care costs. [3] Approximately 10,000 people are admitted to hospital with stroke in Ireland as a primary diagnosis annually. [4] Currently, the only licensed drug therapy for acute ischaemic stroke is thrombolytic therapy with intravenous recombinant tissue plasminogen activator (tPA) which must be given within 4.5 hours of stroke onset to be effective in reducing stroke disability. [5] A recent meta-analysis of 8 randomised controlled trials of tPA therapy in stroke has highlighted the time sensitive nature of this treatment, with earlier therapy resulting in reduced disability. [5] An estimated 2 million neurons die for each minuteâ s delay to reperfusion therapy, therefore the concept of â time is brainâ is critical.6 The number of patients needed to treat (NNT) with tPA, within the 4.5 hour time frame to achieve a satisfactory outcome, falls sharply with time from onset to treatment. [NNT= 5 for 0-90 mins, NNT= 9 for 91-180 mins and NNT= 15 for 181-270 mins]. [5] Furthermore, there is a suggestion that later time to treatment is associated with higher mortality and intracranial haemorrhage.

The tight time window for thrombolytic therapy in ischaemic stroke necessitates rapid presentation of stroke patients to a hospital with the infrastructure to facilitate early rapid assessment and treatment decision making. A key component of the in-hospital assessment of the acute stroke patient is the time from hospital admission to CT brain scan. Measurement of this interval can form part of the assessment of an institutionâ s ability to provide acute care to stroke patients in a timely manner and can also track a hospitalâ s performance over time in rapid stroke assessment and facilitate comparison with other peer institutions. Organised, protocol-driven acute stroke care is essential if acute stroke patients are to receive rapid and comprehensive assessment on arrival in the Emergency Department (ED). The aims of this study were (1) To measure the interval from hospital admission to the Emergency Department to CT brain scan at the MRHM between 2004 and 2009 for all acute ischaemic stroke patients and (2) To determine the impact of a newly created ACSS in January 2008 on this time interval. The new service developed a protocol to assess patients with stroke who may benefit from tPA therapy. This coincided with an educational programme for ambulance paramedical staff using the Face Arm Speech Test (FAST), which required pre-notification of the hospital ED of all incoming FAST positive patients so that a rapid assessment with CT scanning took place, thereby facilitating early decision making regarding tPA therapy.

Methods
A retrospective chart review of all acute ischaemic stroke patients admitted to MRHM between January 2004 and September 2009 was undertaken. Cases were identified from the Hospital Inpatient Enquiry System. Information recorded included date and time of admission to the ED as entered in records as well as date and time of CT brain scan as recorded on each patientâ s CT scan films. Patient age, gender and day of admission were also recorded. This report includes all admitted acute ischaemic stroke patients, irrespective of whether or not they were considered potential thrombolysis candidates. Collected data was entered into SPSS for statistical analysis.

Figure 1: Time of Admission â All Patients 2004 - 2009

Results
496 acute ischaemic stroke patients were admitted between January 2004 and September 2009 of whom 268 (54%) were male (mean age 70.9 years, range 25-99) and 228 were female (mean age 77, range 36-96). Overall, 77.2% were 65 years or older and 51.4% had a Medical Card. The most common day of the week for admission was Monday (18.5%) with a gradual decline throughout the rest of the week to 11.9% on Saturday and 10.5% on Sundays. 54.3% of ischaemic stroke patients were admitted â out of hoursâ (after 5pm on weekdays or on weekends) and 30.8% were admitted on weekends. The time of admission for all patients is shown in Figure 1. Most patients were admitted between 0900 and 2100 between Monday to Friday over the 5 years. Of those admitted â out of hoursâ on Monday to Friday, 70% were between 1700 and 2400. In total, 75.5% of all admissions for acute ischaemic stroke were between 0800 and 2000.

Over the period 2004-2009, a total of 65.1% of acute ischaemic stroke patients had CT brain scan within 24 hours of

admission to the ED with a further 16.4% being scanned between 24 and 48 hours. The median interval to CT scan ranged between 19-24 hours between 2004-2007 (number of patients per annum range 44-97), dropping to 15 hours in 2008 (n=130, p=0.03) when the ACSS was set up and to a median of 3 hours up to September 2009 (n=125, p=0.003). There was no statistically significant difference in time from ED admission to CT brain scan by gender or age. For â out of hoursâ CT scans, the median for 2004-2007 varied between 18-41 hours, dropping to 16 hours in 2008 (p=0.001) and 5 hours in 2009 (p=0.044). For weekend admissions only, the median between 2004-2007 ranged between 19-46 hours, dropping to 17 hours in 2008 (p=0.044) and 5 hours in 2009.

Figure 2: Delay from Admission to CT scan for hyperacute phase of stroke 0-3 hours

The establishment of the ACSS in early 2008 involved the provision of a 24/7 thrombolysis service. The proportion of acute ischaemic stroke patients imaged within 3 hours of ED admission increased to 34.6% in 2008 and 47.2% in 2009 compared with 15.4% in 2004-2007. Looking more closely at time trends within the hyperacute phase (0-3 hours) the proportion scanned in the 0-1 hour window was 21.5% in 2008 (p = 0) and 35% in 2009 (p = 0.018) compared with 4.6% in 2004-7 pre-ACSS. In contrast to the dramatic increase in the 0-1 hour time period, the proportion of patients scanned between 1-2 hours and 2-3 hours respectively was comparable (see Figure 2).

Discussion

The organisation of an ACSS in 2008, from within existing resources, coincided with a dramatic decline in the time from ED admission to CT brain scan for acute ischaemic stroke patients when comparing â beforeâ (2004-2007) with â afterâ (2008 and 2009). We believe that this enhanced organisation of our stroke services was causally related to the significant decline in time to CT scan from admission. Establishing the ACSS re-oriented several community and hospital departments (Ambulance Service, ED, Diagnostic Radiology) to a new hyperacute model of stroke care. This model necessitated that one of the four pre-existing consultant radiologists in the hospital reported all CT scans immediately. Most scans were also reviewed by the consultant physician. An in-house training programme, still on-going, was required to up-skill radiographers to do out of hours CT brain scans. This reorientation, rather than a â hawthorne effectâ from the Irish National Audit on Stroke Care (INASC),[4] explains the dramatic increase in the proportion of patients scanned between 0-1 hour with a flat trend in the 1-2 and 2-3 hour time windows over the 2004-2009 period as neither physicians or radiologists could measure the time to CT in real time over the five year period. Such a policy change was necessary to achieve the gold standard door to CT scan time of 25 minutes[7] and to maximise acute stroke cases eligible for intravenous tPA. Older age and gender had no impact on time to CT scan.

An earlier report from our institution had shown that 64% of all acute stroke patients in 2000 had CT scan within 24 hours of admission.[8] The INASC revealed 40% of stroke patients had a CT brain scan within 24 hours.4 Only 4% were scanned within 3 hours of admission. Kelly et al found that 8.5% of patients in a Dublin teaching hospital had CT scan within 3 hours of admission with 29% still awaiting CT scan at 48 hours after presentation to hospital.[9] Recent data show improvement with a median time from admission to CT scan of 18.7 hours with 70% being scanned within 24 hours.[10] The National Sentinel Stroke Audits in the UK have shown that 59% of stroke patients had CT scan within 24 hours (2008) compared with 42% in 2006, 59% in 2004 and 58% in 2001. Scottish data reports an increase in the proportion of patients imaged on day of admission from 30 to 50% (2004-2009).[11]

Hospitals worldwide have generally been shown to perform better in terms of time to CT scan. UK patients randomised into the 1st International Stroke Trial in 1995-6 took 50% longer than their Italian counterparts to have CT scan performed ahead of randomisation.[12] Evenson et al recently reviewed pre- and in-hospital delay times in acute stroke care.[13] In total, 19 separate studies were published between 2000-2007 with data from admission to CT scan in Finland, Holland, Germany, Greece, USA, Japan, Canada, Philippines, Brazil, Australia and Taiwan.[13] Many studies included transient ischaemic attack, intracranial and subarachnoid haemorrhage which limits comparison with our results. Median delay times of 0.1 to 5.5 hours were found in over 14 studies with the remaining 5 studies reporting a mean rather than a median time delay. A secular decline in time to CT scan of 10.7% per annum was found.[12]

In Ireland, there has been a belated interest in stroke care in contrast with the earlier haphazard and poorly resourced health services for stroke as clearly outlined in the first National Audit of Stroke Care.[14] The IHF Stroke Manifesto 2010 calls on the Irish Government to ensure that emergency health services nationally are equipped to deal with acute stroke and that thrombolytic therapy be available 24/7 for all Irish stroke patients.[15] Organised acute stroke assessment and treatment is also now official Government health policy as recently published in Cardiovascular Health Strategy 2010.[16] On-site 24/7 availability of CT scanning is recommended. In 2008, 27 of 36 acute hospitals had 24/7 CT access. In an effort to increase the proportion of Irish stroke patients admitted to hospital early, the IHF began a public education campaign in May 2010 (ACT-FAST Campaign) which highlights common acute stroke symptoms and emphasises the need to immediately dial 999 to facilitate early acute hospital assessment.[15]

In summary, the time from admission to CT scan declined rapidly co-inciding with the creation of an ACSS in an Irish General Hospital and reorganisation of the initial hospital response to acute stroke. Rapid assessment and treatment would be expected to lead to improved patient outcomes. Time from admission to CT scan is one readily available audit measure of a hospitalâ s ability to respond quickly in the setting of acute stroke. Change of this nature was only possible with the co-ordinated support and assistance from a range of health care professionals straddling the acute hospital and community interface.

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