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Educational Strategies

Acute Stroke Training and Assessment in Computerised Axial Tomography (ASTRACAT) for stroke physicians: facilitating telestroke implementation in a UK setting

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ABSTRACT

Acute stroke specialist assessment and care requires the 24/7 availability of intravenous thrombolysis. Differences in geography and rurality demand differing models of care. Lancashire and Cumbria have implemented a telemedicine solution with a rotating virtual hub out of hours enabling 2-way audiovisual consultations. To minimise treatment delay the stroke physician interprets the acute stroke CT brain scan with recourse to radiology support if necessary. Formalised training and assessment in acute CT interpretation was provided for the participating stroke physicians. This involved a programme of training and assessment days and training material including a standardised CT reading template. Core elements of this material have now been included in the recently launched Ebrain project. In Lancashire and Cumbria, ongoing multidisciplinary meetings with neuroradiology support enabling review of treated cases is helping to facilitate maintenance and development of skills in the interpretation of CT for acute stroke by stroke physicians.

INTRODUCTION

The 2007 UK Department of Health National Stroke Strategy made clear recommendations for the provision of acute stroke specialist assessment and care including 24/7 availability of intravenous thrombolysis. Different models of care have evolved across the UK in order to achieve 24/7 access to iv thrombolysis. For example, in the North West, Greater Manchester has a comprehensive stroke centre delivering 24/7 thrombolysis in Salford, and district stroke centres in Bury and Stockport providing 7am-7pm treatment. But a geographically fixed 'hub and spoke' solution is not applicable in all regions. Lancashire and Cumbria represent a much larger geographical area with patients admitted across eight sites and six acute NHS trusts, with long travel times between sites and no obvious hub.

The Clinical Advisory Group (CAG) of the Stroke Network in Lancashire and Cumbria (SNLC) proposed a telemedicine solution with a virtual hub for out of hours coverage, using broadband technology to connect hospitals with a remote network of stroke specialists. This enables the physician, based at home outside working hours, to carry out a live two-way audiovisual consultation with the patient and local medical teams and review CT scans [1]. The telestroke service was launched in July 2011.

Whilst out-of-hours local DGH general radiology support is available, immediate interpretation of acute CT scans usually falls to the stroke physician providing the remote telemedicine assessment in order to

minimise delay in the administration of iv thrombolysis. It was considered appropriate for the stroke physicians participating in the telestroke rota (telestroke consultant) to achieve some formalised training and assessment in acute stroke CT interpretation. Informal discussion with various general radiologists and neuroradiologists led the authors to believe that there are some widely held pragmatic viewpoints entirely in line with our approach – namely that (1) stroke physicians and neurologists are well placed to build on existing informally acquired skills in CT interpretation, in view of the number of CT brain scans they view during routine clinical work, (2) neuroradiology support would remain the gold standard but that this was not feasible on account of there currently being too few neuroradiologists. The SNLC wrote to radiology clinical directors at all network acute trusts to advise that the training and assessment programme was to be run.

METHODS

We developed and delivered ASTRACAT (Acute Stroke Training and Assessment in Computerised Axial Tomography). Following discussion between the authors and the SNLC, a programme was proposed, affording all stroke physicians the opportunity to attend one training day and one assessment day each, separated by approximately two weeks to provide an opportunity to assimilate training material. Royal College of Physicians (RCP) Continuing Professional Development (CPD) accreditation was obtained for the programme, whose learning objectives were as shown in Table 1. Face-to-face training was favoured over the sole use of existing online learning resources.

ASTRACAT format

IWT (experienced neuroradiologist) facilitated an interactive training day on CT interpretation using an extensive collection of cases accompanied by imaging. This format enabled detailed discussion and exploration of problem areas to take place. Training material (a copy of the PowerPoint presentation including cases with annotated images from the day) was provided to all attendees. The training day was followed up by an assessment day (approximately 2 weeks later) which mainly involved viewing within PACS of 'real cases' using a working template for CT interpretation (Table 2) devised by IWT. The cases included patients presenting acutely to the Royal Preston Hospital over the preceding 6 months with suspected acute stroke who had either been screened for, or treated with, intravenous rt-PA. ASTRACAT was subsequently delivered on a further occasion.

Participants

In total 29 physicians (comprising Stroke Physicians, Neurologists and Emergency Physicians) attended over two cycles of the ASTRACAT programme. Two additional physicians who joined the Lancashire & Cumbria Telestroke rota, and for whom ASTRACAT was not available at the time of their joining, were advised to undertake alternative online training (Table 3).

Table 1. ASTRACAT learning objectives.

- Recognition on CT in the setting of assessment of suspected acute stroke to facilitate administration of intravenous thrombolysis
    - (i) haemorrhage including subarachnoid haemorrhage (SAH), intracerebral haemorrhage (ICH) and infarction with haemorrhagic transformation
    - (ii) recognition of early ischaemic changes
    - (iii) recognition of arterial territory (anterior cerebral artery [ACA], middle cerebral artery [MCA], posterior cerebral artery [PCA])
- Evaluation of CT signs of acute ischaemic stroke by use of ASPECTS (Alberta Stroke Program Early CT Score) [2].
- Achieve an understanding of
    - (i) role of advanced techniques especially CT perfusion (CTP), and gain an appreciation of imaging dead core from salvageable penumbra
    - (ii) one's own limitations and thus - when to refer or call in "expert" assistance
    - (iii) stroke mimics — things that look like stroke but aren't, as well as things that look like something else but are strokes

Table 2. Working template for viewing CT brain images in suspected acute stroke.

CT Normal

- Ventricles - symmetrical (no midline shift); normal size for patient's age; ventricles and sulci appropriate in size for age
- Sulci & fissures (CSF spaces) symmetrical on both sides (no effacement)
- Grey/White differentiation maintained

CT Abnormal

Haemorrhage (blood clot) anywhere (ICH, IVH, SAH, Extra-axial)

If ICH (remember age of patient, comorbidities)

- Location (lobar or deep – basal ganglia, cerebellum or brain stem)
- Simple
- Complex
- Oedema
- Overall mass effect

Stroke mimics

- Herpes simplex encephalitis
- Arteriovenous malformation
- Neoplasm
- Other

Early Ischaemic Changes

Vascular Territory

- ACA
- MCA
- PCA

Early Signs of MCA Ischaemia

- Loss of Insular ribbon
- Loss of Grey/White Differentiation in relation to caudate, lentiform nucleus, internal capsule
- Hypodense caudate or lentiform nuclei

ASPECTS (only for MCA)

- *10 minus 1 for involvement of each of M1, M2, M3, M4, M5, M6, caudate, internal capsule, lentiform nucleus, insula. M1 to M6 refer to anterior inferior frontal MCA cortex (M1), temporal lobe MCA cortex lateral to the insular ribbon (M2), posterior temporal MCA cortex (M3), with M4, M5 and M6 representing corresponding anterior, lateral and posterior MCA cortices immediately rostal to M1, M2 and M3 respectively.*

Table 3. Examples of online resources for CT brain training relevant to acute stroke.

- Internet Stroke Center - CT Learning Tool http://www.strokecenter.org/education/ais_ct_tool/
- BASP CT Training Series - http://www.neuroimage.co.uk/basp/
- Understanding Alberta Stroke Program Early CT Score (ASPECTS) http://www.aspectsinstroke.com/
- ACCESS - http://www.neuroimage.co.uk/access/

Table 4. Keys session points.

- CT is usually the first line imaging modality for acute stroke
- Imaging excludes mimics and helps to confirm the clinical diagnosis
- Familiarity with normal anatomy and cerebral arterial territories facilitates
- Interpretation of acute stroke CT
- Acute haemorrhage is readily appreciated on CT in most cases
- Established infarcts generally demonstrate specific key attributes, e.g. low attenuation, wedge shaped, known arterial territory
- Signs of early ischaemia are arguably best identified using a systematic approach

RESULTS

Telestroke service data

Over the first 12 months (July 2011 – July 2012) during which the Lancashire & Cumbria Telestroke service was operational, there were 342 calls for advice to the service. In addition to these calls, there were 317 telemedicine assessments, leading to the administration of iv thrombolysis in 129 patients. Clinical outcome data for the Lancashire & Cumbria Telestroke service indicate that the 3 month mortality rate for patients receiving iv thrombolysis was 18%, in line with expected mortality rate.

Requests for radiology support

During this period, 48 requests for support were made to local DGH general radiologists. Seven (14.6%) of these requests were for a second opinion for interpretation of the scan by a radiologist. 20 (41.7%) requests arose because the scan had not been made available on the image exchange portal and could not be seen by the telestroke consultant. Interpretation by the local general radiologist therefore became necessary. In 7 (14.6%), the request was made by the local hospital to their own radiologist for interpretation of the scan (in addition to the interpretation by the telestroke consultant) owing to lack of familiarity with the out of hours clinical pathway. The reason for contact with the local radiologist was not captured in 14 (29.2%).

Lancashire & Cumbria Telestroke service: current position

Participating stroke physicians are invited to attend regular multidisciplinary meetings for discussion of cases, and in many instances review of acute CT images. There is input into these meetings by neuroradiology wherever possible. Continuing review of treated cases, with discussion of clinical presentation alongside radiology, including audit of mortality, helps to facilitate maintenance and development of skills in the interpretation of CT for acute stroke. Fourteen of the physicians participating in the rota have also undergone a single day's refresher training facilitated by IWT.

Dissemination

The opportunity arose to incorporate core elements of ASTRACAT within a module for the Ebrain project (http://www.ebrainjnc.com/), which launched on 25 November 2011. As a result, HCAE and IWT wrote "Basic Principles of CT Interpretation for Acute Stroke (parts 1 and 2)", with the following learning objectives:

- Specify normal anatomy and cerebral arterial territories
- Define haemorrhage
- Describe an infarct
- Define early ischaemic changes

Key points covered in the Ebrain session are listed in Table 4.

DISCUSSION

Agreement among experienced stroke specialists and other physicians on the presence of early CT ischaemic changes has been investigated previously, and substantial variability was identified [3]. More recently, a large scale observer reliability study of doctors in stroke-related specialties has been conducted via the internet [4]. Slower scan reading and the use of CT infarct rating scales were found to improve the detection of acute ischaemic signs. These findings underline the importance of encouraging a systematic approach to the interpretation of acute stroke CT imaging.

The American Stroke Association has set out detailed recommendations for the implementation of telemedicine, which cover the feasibility and reliability of remote assessment of neuroimaging [5]. In essence these state that teleradiology systems are recommended for the timely review of brain CT scans in patients with suspected acute stroke; that review of brain CT scans by stroke specialists or radiologists using teleradiology is useful for identifying exclusions for thrombolytic therapy; and when implemented within a telestroke network can be effective in supporting rapid imaging interpretation in time for thrombolysis decision making.

The level of agreement of baseline brain CT scan interpretations of patients with acute stroke between neuroradiologists and 'spoke' hospital radiologists and 'hub' hospital vascular neurologists has been studied very recently [6]. This study found excellent agreement over the presence or absence of radiological contraindications to thrombolysis.

Currently however there is no standardised formal training in the UK with respect to acute stroke CT interpretation for stroke physicians – and in particular those engaged in telemedicine rotas for acute stroke. There is a need for a high quality standardised educational resource as a means of preparation for and demonstration of continuing competency to participate in, acute stroke (including telestroke) rotas.

The delivery of ASTRACAT to a relatively heterogeneous group of stroke physicians, drawn from geriatric and acute medicine backgrounds with varying proportions of their working time dedicated to stroke, in a UK setting has helped to facilitate the implementation of the telestroke service in Lancashire & Cumbria. This has enabled the telestroke consultant to provide the initial acute CT scan interpretation, and subsequent telestroke service data do indicate that requests to local DGH radiologists occurred in a minority of cases. Furthermore, telestroke service clinical data indicate no significant safety concerns in the first year of its implementation.

CONCLUSION

Our experience in Lancashire and Cumbria is likely to resonate with other stroke services in the UK and elsewhere. Stroke physicians are well placed to build on existing informally acquired skills in CT interpretation – and, in practice, immediate recourse to neuroradiology support is often not possible. We consider our approach to represent a pragmatic solution – through the development of relevant training and a standardised CT reading template. Valuable 'spin-offs' include the Ebrain module which is now widely available. Locally we will certainly aim to ensure continued review of practice in a multidisciplinary setting.

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