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CT head reporting by radiographers: Results of an accredited postgraduate programme

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ABSTRACT

Aim: To evaluate the results of the summative objective structured examination (OSE) for the first four cohorts of radiographers ($n = 24$) undertaking an accredited postgraduate course in reporting computer tomography (CT) head examinations.
Method: The construction of a summative OSE contained twenty five CT head examinations that incorporated 1:1 normal to abnormal pathological examples. All cases were blind reported by three consultant radiologists to produce a valid reference standard report for comparison with the radiographer's interpretation. The radiographers ($n = 24$) final reports ($n = 600$) were analysed to determine the sensitivity, specificity and agreement values and concordance for the four cohorts.
Results: The four cohorts (2007–2013) of postgraduate radiography students' collective OSE results established a mean sensitivity rate of 99%, specificity 95% and agreement concordance rates of 90%. The final grades indicate that within an academic environment, trained radiographers possess high levels of diagnostic performance accuracy in the interpretation of CT head examinations.

Introduction

The role and scope of radiographer reporting of computer tomography (CT) examinations is still an evolving practice in the United Kingdom (UK). A recent survey by the Society and College of Radiographers (SCoR)[1] established at least 17 sites in the UK are now supporting this role extension and to assist service provision. Support to develop radiographers' roles into this area of practice has been promoted by Royal College of Radiologists (RCR) and the SCoR team working guidance.[2] Evidence to develop reporting radiographers in practice has been illustrated through the RCR Clinical Radiology Workforce report[3] which established the current working population of radiologists within the UK and suggested the considerable challenges posed by the shortage of radiologists, and the increasing amount of unreported imaging. This has led some clinical radiology departments to introduce an effective skills mix of radiologists and radiographers reporting to cope with the current demand in imaging services and report turnaround times.[4]

Important drivers that have encouraged this role extension include the impact of dedicated guidance to recommend timescales for reporting. The National Diagnostics Imaging Board (NDIB)[5] issued guidance advocating that reporting turnaround times for urgent imaging examinations to be within 30 minutes, inpatients and accident and emergency patients within the same working day, and ideally all other cases by next working day. Specifically the National Institute for Health and Care Excellence (NICE) Head Injury guidelines (CG176)[6] key priorities and recommendations include CT scanning patients with suspected head injuries within 1 hour of admission with a written provisional CT report within 1 hour of scanning. The NICE Stroke guidance (CG68[7] and QS2[8]) recommends immediate CT scanning and recognises the importance of urgent CT reporting on the therapy management and treatment of the acute patient.

A study by Clarke et al.[9] which included 23 service managers and 48 CT head reporting radiographers attempted to identify key barriers to the development and implementation of CT head reporting by radiographers. Factors included a lack or reluctance of radiologists to participate as mentors in training and teaching, and staff shortages reducing the possibility of radiographers being released to study. Both of which have impacted upon the number of candidates applying for places on postgraduate programmes over recent years, this has led to a decrease in the availability of post graduate courses provided by higher education institutes in the UK.[9] Several National Health Service (NHS) Trust Imaging

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departments[1] have taken action in response to these policies[2,4–8] and guides[10] and commenced role extension initiatives supported by the SCoR[11] to instigate CT head reporting by radiographers who have attained a recognised qualification in CT head reporting.

Radiographers undertaking an approved course of training have the potential to improve service delivery and provide an innovative approach to reporting demands and capacity.[3,4,6–8] The 12 month postgraduate programme in clinical reporting of CT head examinations at Canterbury Christ Church University (CCCU) consists of clinical department tutorials and clinical experience in reporting, supported by a series of briefing blocks conducted at the university campus every three months throughout the programme.[12] Consultant radiologists with extensive CT experience and proficient CT head reporting radiographers participate in the construction, organisation, lecturing and assessment components of the curriculum. The assessment strategy includes a written clinical case study, a reflective audit of the student's developing competence in CT head reporting and 375 written reports, 250 reviewed and evaluated by the students allocated workplace consultant radiologist mentor. The final assessment of the student's ability to report CT head examinations concludes with the interpretation of an objective structured examination (OSE) image bank of 25 CT head examinations.

Objectives

(1) To analyse and establish the diagnostic performance accuracy of the first four cohorts of radiography students who finished the postgraduate programme in CT head reporting.
(2) To evaluate the concordance ratio for a small representative cohort of radiographers against the reference standard of a small designated sample of radiologists.

Method

An element of the candidate's proficiency of the training involved the students reporting a bank of 25 CT head investigations in the format of a written OSE under controlled examination conditions using low level lighting and high definition reporting monitors[13] that meet the 2012 RCR reporting specification standards[14] (42 cm, 1280 × 1084 screen resolution, >170 cd/m^2 luminance, ≥250:1 luminance contrast ratio). The case studies were displayed in Digital Imaging and Communications in Medicine (DICOM) format using KPACS software[15] to enable manipulation.[14]

During the construction of the OSE, a large bank of CT investigations were reported independently by three experienced consultant radiologists who routinely report CT head examinations as part of their clinical role. Twenty five cases of CT head investigations of 1:1 normal to abnormal examples were agreed upon. Expected responses (compiled from the reports of three consultant radiologists) for each of the 25 examinations submitted for each OSE, were then agreed and approved by the programme panel and external examiner (independent consultant radiologist), who verified that a suitable range of subtle discriminatory examples were incorporated. A variety of investigations were featured to sufficiently assess the students' knowledge and skills whilst demonstrating competence and proficiency to a high degree. Characteristic abnormal pathological examples included a range of: acute and chronic subdural and extradural hematomas, subarachnoid haemorrhages, intracranial and intraventricular haemorrhages (including traumatic multi-site haemorrhages with cranial fractures). Ischaemic and haemorrhagic infarctions, primary and secondary malignant and benign cerebral tumours. With additional incidental findings, particularly in the cerebral hemisphere category, including ischaemic small vessel disease, physiological involution, benign calcification, and previous surgical intervention.

Candidates were provided with demographic details which included each individual case's patient details including gender, age, referral source (accident and emergency, in-patient, out-patient or general practitioner) and clinical history provided at the original CT investigation. The candidates were required to state if the examination was normal or abnormal, detailing their evaluation on a pre-provided answer booklet by ticking a formatted checkbox. The radiographers were further instructed to categorise normal variant anomalies as normal. If the investigation was deemed abnormal the candidates were then required to write a detailed report outlining the key abnormal findings and suggested pathology(ies), and where necessary supporting differential diagnosis, in the form of a free text response answer. During the course of the programme candidates were taught to provide logically organised responses to identify findings and methodically describe the exact anatomical location, providing additional supporting details to justify and support the diagnosis. Examples include mass effect on surrounding structures and sulci, midline cerebral shift, herniation of anatomy (and direction of herniation), and if a lesion is seen the size (in mm) and lesion outline (smooth, nodular, ring, irregular and contrast enhancing characteristics).

Marking criteria for the OSE

A statistical measure of the candidates' performance for the OSE normal/abnormal decision and detailed free text responses were statistically assessed against the expected answers by a first and second marker from the programme panel and the external examiner consultant radiologist.

Responses were classified as true positive (TP), true negative (TN), false positive (FP) or false negative (FN), using partial marks as described in a previous study.[16] All responses which indicated definitely normal were regarded as normal and scored TN or FP accordingly. All other responses were regarded as abnormal and scored as TP or FN. Resulting TP, TN, FP and FN fractions (whole and partial) were summed.

The marking criteria additionally allocated a points scoring system using a binary coding method for each abnormal case out of a possible total of 5 points, allowing a fractionated score to be given in the case of multiple abnormalities present, as applied in previous studies.[17] In free response answers where specific multiple abnormalities and locations were present the recording of these details has significance and potential to impact on patient outcomes, and affect the validity of the result. Correspondingly if individual elements of incorrect location or pathology were recorded or described as normal, points are reduced from the total possible score available.

Each normal case received one mark and an abnormal case had the opportunity of up to five marks awarded. Examples of mark distributions for an abnormal CT case are: Abnormal 1, Side: Right 1/4, Location: occipito-parietal lobe 1/4, Size: 26 mm × 20 mm 1/4, Mass Effect: effacement of local sulci 1/4, Oedema: minor surrounding oedema 1/4, Density: heterogeneous/mixed lesion 1/2, Contrast: hyper-dense irregular ring enhancement 1/4, Pathology: glioma 1, Differentials: metastasis 1.

The final OSE total agreement, sensitivity and specificity were then calculated[13] for the candidate. Final radiographer scores were judged against a predetermined pass mark of 85% agreement and 90% sensitivity and sensitivity compared to the three independent radiologist reports.

It is well known that variation exists even between experience observers when interpreting medical images. When comparing the opinions of general radiologists and neuroradiologists in the