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Review article

Radiographer advanced practice in computed tomography coronary angiography: Making it happen

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ABSTRACT

Cardiac computed tomography (CT) is a rapidly evolving technique for assessing cardiovascular disease which usually requires direct, time-consuming supervision by a radiologist or cardiologist for the whole examination. The cardiac radiologists at our institution decided to train CT radiographers to perform CT Coronary Angiography (CTCA) examinations independently. The aim of the initiative was to enable appropriately trained radiographers to perform the CTCA examination autonomously and to a high standard.

Following the programme of training and development, participating radiographers have been shown to undertake CTCA examinations to the required standard, providing a safe, effective and patient focused experience, with no detriment to patient care or radiation dose received. Evidence of service enhancement which allows radiologists to undertake other work, has also been established. This paper describes the steps in the design of this new service and how advanced practice role development has been established and assessed at our institute.

Introduction

Radiographers' roles have been evolving in diagnostic imaging over the last two decades in response to service demand and in line with government policy. Interest in improving service delivery is neither new, nor restricted to the United Kingdom (UK) and new roles have often been driven by modernisation policies[1,2]. The driving and ongoing desire for change has been supported by the ambition to utilise and maximise the talents and skills of the existing workforce, enabling staff to work across traditional professional boundaries.[3]

Since around 1990, UK radiology literature has seen a marked increase in publications on the advanced clinical work in which radiographers engage. Advances in technology, changes in medical practice and health policy have created situations in which advanced roles are more likely to be supported.[4] These factors have coincided with the pioneering work of advanced practitioners, with aspirations towards high-level clinical careers, supported by a published evidence base of competence in radiographer advanced practice. The radiographers' Scope of Practice report[5] provided examples of emerging new roles, suggesting that diversity of radiographic practice continues to expand. Radiographer reporting has been sustained in fields of skeletal, magnetic resonance imaging, bone densitometry and emergency ultrasound[6–8] and practice innovations such as guidewire and feeding tube insertions, with radiographers practicing interventional procedures have evolved.[5] These examples demonstrate a definitive shift in practice, where many roles previously dominated by radiologists are now being executed by autonomous practice, with radiographers entering into advanced practice and consultant positions.

While the catalysts for change have been supported by combinations of staff shortages and developing technologies,[9] the increase in range of imaging modalities had resulted in greater demands for radiology services and role requirements. The consequences of skill shortages have provided the opportunity to champion new skill mix profiles, supporting new ways of working.

Although there is national variation, greater engagement in advanced practice is now well recognised within the radiography field. This firmly brings into context the area of cardiac imaging. Cardiac CT is recognised as a valuable first line non-invasive investigation for a variety of cardiac diseases, most notably coronary artery disease[10]. NICE guidelines published in the UK advise on its use in patients with recent onset of stable chest pain.[11] In addition the technology required to perform cardiac CT effectively,

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a multislice scanner with a 64-slice or greater detector array, is now available in most UK hospitals.

Cardiac CT is a complex investigation usually requiring intense radiologist supervision and intervention if it is to be performed to a high standard and with minimum radiation dose to the patient. Patient selection can heavily influence results, with substantially impaired image quality in patients with higher heart rates or arrhythmias.[12] Image quality may also be degraded in patients with severe coronary artery disease due to the presence of extensive calcifications which potentially limit precise assessment of the stenosis severity.[13] The role of the radiologist includes, among other things:

i) Whether the administration of intravenous beta-blocker is required
ii) Administration of the required dose to achieve the optimum heart rate
iii) Administration of sublingual glyceryl trinitrate (GTN) to dilate the coronary arteries
iv) Deciding on the acquisition protocol, which is based on heart rate and patient habitus
v) Assessing the images for diagnostic quality
vi) Deciding if additional imaging is required which includes choosing the z-axis volume to be re-scanned and what form the repeat acquisition should take

This requires the radiologist to be physically present in the CT control room for most of the duration of the procedure.

The cardiac radiologists at our hospital decided to train three experienced CT radiographers to perform CT Coronary Angiography (CTCA) independently, so that they would only be required to provide minimal input during the examination. This would leave them free to perform other consultant duties within the department. This multidisciplinary mode provided us the opportunity to develop radiographer advanced practice shaped around local service needs, which crossed professional boundaries.[3] The aim of the initiative was to provide a cost-effective and efficient service to patients by training radiographers to be competent in performing and reviewing the CTCA examination. This included image assessment and drug administration without direct supervision from a radiologist. This paper describes the steps in the design of this new service and how it has worked out in practice to provide valid guidance, highlighting how the service developed to meet service need.

Methods

Expressions of interest were sought to identify individual radiographers who were keen to undertake advanced practice roles and subspecialise in cardiac CT imaging. The principle selection criteria included a minimum of two years CT experience and ability to demonstrate clinical expertise and make complex decisions in clinical practice. The radiographers had displayed the ability to undertake independent study at post-graduate level. The initial training requirements included extensive support by the cardiac radiologists as mentors to the trainees. This involved support through observations, supervision and independent review. In addition to this, to underpin theoretical knowledge, education in anatomy, physiology, electrocardiogram (ECG) interpretation and cardiac CT specific image acquisition was undertaken.

The recruited radiographers subsequently attended two dedicated external courses at the beginning of the project to provide the foundation educational elements involved in imaging the heart. The first was a Cardiac Radiographers CT course entitled– 'A practical approach to undertaking cardiac CT', (Royal Brompton and Harefield). This course was endorsed by Society of Cardiovascular Computed Tomography and Society of Radiographers at the time the course was undertaken. This course taught the skills of image acquisition and how to systematically review and interpret the data available from a cardiac study. Topics covered included cardiac anatomy, characteristics of cardiac disease, ECG's, clinical applications of cardiac and vascular CT and live patient scanning. The second course attended was the Cardiac CT Trainers Partnership, Level 1 Cardiac Training Programme, which is accessible to radiographers, as well as radiologists and cardiologists, this was endorsed by the Society of Cardiovascular Computed Tomography, The Royal College of Radiologists, and the British Cardiovascular Society. This included lectures and dedicated workstation based training. Each radiographer also attended a CT study day on Advanced Cardiovascular Imaging hosted by the Royal Society of Medicine. Finally, in-house ECG training and pattern recognition with undertaken with cardiology technicians, enabling the interpretation of both normal and abnormal ECG tracings. Whilst these courses do not currently offer post graduate qualification, they do offer transferability. The courses provided the tools and the opportunity to develop skills to conduct cardiac imaging underpinned by a theoretical framework, providing hands-on practical training on similar equipment and workstations for image review and interpretation.

Training with the cardiac radiologists within the department was developed in a systematic way. Initially each cardiac CT session was directly supervised by a radiologist. The three radiographers, in conjunction with the two radiologists and the radiology nurse, developed written protocols for each step of the imaging process as follows: pre-procedural nursing checks, heart rate control, calcium scoring, performing the angiogram, assessing the study, choosing parameters for additional imaging if this is required and patient aftercare. The guidance documents which resulted from the above process, were available on-line on the hospital intranet and in print format to help guide the radiographers when performing the cardiac CT examinations. Four of the guidance documents can be seen in Figs. 1–4, initial patient assessment; performing the angiogram; image and vessel assessment and the nursing flow chart. At our institution all CTCA scans are performed on a Siemens Definition Flash scanner, therefore any terminology is related specifically to this scanner.

Group meetings took place to discuss issues and ensure that information was disseminated. This created an open forum for imparting knowledge and sharing experiences. The direct input from the radiologists facilitated discussions between the team on rationale for decision making.

Heart rate control is a crucial part to achieve a high quality cardiac CT acquisition. Slow, steady heart rates increase dose optimisation and image quality. Previously, the radiologist would need to be present to administer appropriate drug regimes. In order for advanced practitioners to operate independently Patient Group Directives (PGD's) were developed and approved by the Trust's Drugs and Therapeutic Committee. These allowed them to administer both intravenous Metoprolol Tartrate and sublingual glyceryl trinitrate (GTN). The PGD's allow suitably qualified, signed up radiographers to administer these medications without waiting for the radiologists to attend with all the due safeguards in place. This ensured a more timely patient pathway, minimising the time spent in the department and improving patient care. The cardiac radiologists trained and taught the radiographers during the cardiac CT sessions and supervised them for the first 25 cases of GTN administration and 25 cases of metoprolol administration. They also checked the first 50 calcium scoring assessments the radiographer performed using the calcium scoring software on the CT workstation. There was a gradual transition from full radiologist

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