The Role of the Radiographer in Computed Tomography Imaging

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Summary

In line with the Society and College of Radiographers “Role of the Radiographer” promotional resources https://www.sor.org/about-radiography/promotional-resources a new document defining the Role of the Radiographer in CT has been produced. It illustrates the technological growth of CT and its pivotal position in the diagnostic pathway. It demonstrates the diverse skills, experience and personal qualities required of the radiographer in the modern and challenging CT environment.

It is intended to be of interest to radiographers either seeking to expand their role into CT or to advance their current practice within this specialist imaging modality.

It aims to offer support for existing leaders of CT services and to provide guidance for those seeking to commission new or additional services.

1.0 Introduction

Computed Tomography (CT) has been available as part of a diagnostic imaging pathway since the early 1970s. From its inception as a tool to image the brain in cross section, the technological advances in the speed and resolution of CT have resulted in its current strategic position in the diagnosis, planning and surveillance of disease throughout the body.

In 1979, its valuable contribution to medicine was recognised. The Nobel Prize in Physiology or Medicine was awarded jointly to Allan Cormack and Godfrey Hounsfield for the development of “*computer assisted tomography”* as it was originally known.[1]

Since then, technological developments include the growth of multi-slice scanners, dual source and dual energy scanners and iterative reconstruction techniques. Diagnostic and Therapeutic radiographers perform CT examinations of the body to diagnose injuries and diseases and to plan treatment. They are registered healthcare professionals who are competent to practice autonomously. The role of the Diagnostic and Therapeutic Radiographer in CT has grown and the skill sets required to be a CT radiographer in a modern and challenging health and social care setting are diverse.

CT is used for:

· Rapid diagnosis of life-threatening injuries in major trauma, acute stroke, pulmonary embolus or haemorrhage (24/7 access)

· Primary diagnosis and staging of many cancers. Follow up scans to assess disease progression

· Assessment of the coronary arteries and cardiac anatomy in patients with suspected cardiac disease

· Imaging of major blood vessels of the brain, body and extremities to assess and plan treatments such as stent insertions, for example, in abdominal aortic aneurysm

· Guidance for diagnostic and therapeutic interventions such as biopsy, drainage of collections, radiofrequency ablation treatment of some tumours, spinal and musculoskeletal injections for pain relief

· Pre-operative planning of orthopaedic surgery

· Investigation of injury in paediatric suspected physical abuse

· Planning of radiotherapy treatment.

Compared to conventional radiography, CT enables far better differentiation of soft tissue structures such as brain, lung, liver, bowel and fat, which can be imaged simultaneously with bone. CT is especially useful in detecting both focal and diffuse abnormality and can accurately identify size, number, spatial location and extent of lesions such as tumours and blood clots.

2.0 Clinical Applications of CT

2.1 Trauma

Trauma CT has changed over recent years in response to National Institute for Health and Care Excellence (NICE) and RCR guidelines and with the incorporation of the military protocol for whole body CT.[2] Trauma scanning has improved both in terms of the volume and the value of data produced. Patients benefit from reduced risk due to less time spent in the scan room and faster diagnoses owing to better image quality.

2.2 Diagnosis of diseases and staging of cancer

CT aids the diagnosis and surveillance of many diseases throughout the body including cancer.

2.3 CT use in Nuclear Medicine / PET

CT is currently used in Nuclear Medicine for: 1) supplementing gamma camera images with anatomical information to help confirm aetiology (non-fused); 2) co-registration (fusion) of high quality anatomical information with physiological information produced from SPECT or PET imaging; 3) attenuation correction of SPECT and PET images.

CT image co-registration for SPECT and PET has become standard practice for many examinations, enabling a more accurate diagnosis and more accurate planning of treatment in oncology. There are also non-oncological uses for gamma camera SPECT/CT e.g. in cardiac and MSK imaging. Fused data attenuation correction, improves image positional and functional data accuracy.

CT in nuclear medicine is further discussed in the professional document entitled Computerised Tomography (CT) scanners in Nuclear Medicine facilities; use by nuclear medicine practitioners from both radiographic and technologist backgrounds.[3]

2.4 Vascular studies

The use of CT with rapid injection of intravenous contrast agents allows arguably “non-invasive” visualisation of blood vessels. CT is readily available and quick to perform. Faster tube rotation times in cardiac CT have enabled greater visualisation of the coronary arteries in a beating heart. Coronary computed tomography angiography (CCTA) is now more widely available as a non-invasive tool for the diagnosis of coronary artery disease (CAD).[4]

Patients may also undergo investigation of the arteries supplying the lungs with CT pulmonary angiography, which helps to identify blood clots known as PEs (pulmonary emboli).

CT can assist in the diagnosis of acute stroke by excluding haemorrhage as a cause. CT intracranial angiography highlights the blood supply to the brain. It can detect ischaemic stroke and determine the potential benefit of recanalization treatments such as intravenous thrombolysis or intra-arterial clot extraction. Rapid diagnosis and early treatment can have a profound impact on the quality of life a patient experiences following a stroke.

2.5 Intervention

CT guided intervention provides an opportunity for sampling or biopsy of abnormal tissue. It provides guidance in the placement of drains used in the therapeutic treatment of conditions such as infective collections. This enables patients, who may not be fit for conventional surgery, to have access to potentially life- saving treatment.

CT guided fluoroscopy can be used in interventional procedures such as injections, biopsies, drainages and radiofrequency ablations (a treatment using high-frequency electrical currents that create heat to destroy cancer cells).

2.6 Paediatrics

CT is one of several imaging pathways used in the investigation of diseases such as cancer in children.

2.7 CT planning in therapeutic radiography

Therapeutic radiographers use CT simulators to plan radiotherapy treatment.

3.0 Other Uses of CT

Radiographers may be involved with other applications of CT in forensic and archaeological investigations and research.

Less commonly, CT has been used in the non-destructive examination (NDE), or non-destructive inspection (NDI) of materials. Radiographers in the independent sector may be involved in the acquisition of these images for commercial industry.

4.0 Knowledge and Skills

4.1 Governance

Governance in health and social care is more apparent than ever. All healthcare professionals must act in accordance with the standards of conduct, performance and ethics set by their regulatory body. For radiographers this is the Health and Care Professions Council (HCPC).[5] There is a professional expectation that radiographers behave in a way that reflects the Society and College of Radiographers’ (SCoR) Code of Professional Conduct.[6] They must develop and work within their own

personal scope of practice.[7]

Radiographers are accountable under national legislation including the Ionising Radiation (Medical Exposure) Regulations (IRMER) 2000,[8] Ionising Radiation (Medical Exposure) Regulations (Northern Ireland) 2000[9] and subsequent amendments, 2006[10] and 2011[11], the Ionising Radiations Regulations 1999 (IRR'99)[12] and Health and Safety at Work Act 1974[13] as well as local policies and procedures.

4.2 Training and continuing professional development (CPD)

The National Occupational Standards for CT scanning[14] represent the basic skills for all radiographers working in CT whether on a rotational basis or as a permanent CT team member. In both cases, the radiographer must have expertise that builds upon pre and post registration education and training to work safely and effectively. In addition to this, radiographers undertake further training and education to Master (MSc) and Doctorate (PhD) level in order to extend their scope of practice to advanced and consultant practitioner standards. The College of Radiographers (CoR) offers an accreditation scheme for advanced[15] and consultant[16] level practice.

Evidenced CPD is an explicit requirement for registration and is not to be underestimated. The Committee on Medical Aspects of Radiation in the Environment (COMARE) 16th report[17] refers to NHS statistics that show an increase of five times in the number of CT scans performed during 2012/2013 when compared to 1996/97. The report highlights the increased average radiation dose to the population. In response to this, the Department of Health (DoH)[18] recommends: "the inclusion of the potential risks associated with CT scans should also be part of continuing professional development (CPD), which is essential for accreditation/reregistration for healthcare professionals." It further advises, in response to recommendation 7 of COMARE 16,[17] the development of Imaging Optimisation Teams or radiation protection champions, consisting of a radiologist, a radiographer and a medical physicist to ensure a consistent approach to good practice in CT services. It recognises the need for senior NHS leadership in order to achieve this.

The radiographer has a duty to understand medical terminology and abbreviations in order to produce high quality CT images safely. They will apply their anatomical, physiological and radiographic knowledge to ensure the scan is appropriate, justified and meets the needs of the patient. They must also ensure that the patient is safe and comfortable and treated with respect, compassion and dignity at all times.

Radiographers employ knowledge of, and adhere to, national and local policies on manual handling, basic and immediate life support, infection control, patient identification and record management.

Radiographers require additional training to operate peripheral devices such as Electrocardiogram (ECG) machines and contrast agent delivery systems safely. This may be undertaken by a combination of in-house training and courses accessed via the SCoR website: https://www.sor.org/learning/post-registration-courses/certificate-of-iv-administration

Computer systems enable faster and more effective communication between patient care teams. Electronic requesting of CT examinations means that radiographers must be trained and competent in the use of these systems. Information is stored and managed to facilitate staff training, audit and research and to help improve safety, consistency and reproducibility of techniques.

4.3 Duties of the CT radiographer under IR(ME)R

CT is a high radiation dose technique by comparison to conventional x-ray.[19] In order to safeguard the patient and others throughout this diagnostic pathway the CT radiographer must have a thorough understanding of radiation protection and their duties under IR(ME)R[8,9,10,11] and IRR'99.[12]

The radiographer in CT may act as an IR(ME)R operator and/or IR(ME)R practitioner. In both cases they must prove adequate training and be entitled to do so by their employer. They must comply with employer's procedures.

The Society and College of Radiographers (SCoR), The Royal College of Radiologists (RCR) and the

British Institute of Radiology (BIR) have jointly produced a guidance document, with support from Public Health England (PHE) and the Institute of Physics and Engineering in Medicine (IPEM), aimed at employers and staff who provide clinical imaging and interventional radiology services using ionising radiations.[20]

As the IR(ME)R operator, the radiographer in CT, when entitled, is responsible for any practical aspect of the medical exposure and this may include the authorisation of exposures under agreed and relevant authorisation guidelines.

As the IR(ME)R practitioner in CT, the radiographer, when entitled, is responsible for the justification of the medical exposure.

The radiographer in CT must also ensure compliance with IRR'99 abiding by the Local Rules to ensure occupational exposures are kept as low as practicable.

They must be aware of the national and local diagnostic reference levels (DRLs) and dose constraints established for the examinations they undertake, particularly in relation to children and young adults.[21]They must work closely with paediatric specialists and take particular care when scanning this age group who are particularly sensitive and vulnerable to cumulative lifetime risks of cell damage caused by radiation. [21,22,23]

A fundamental understanding of the physics of CT is a prerequisite. The optimisation of scanning protocols is vital to the safe delivery of radiation and is a responsibility of the radiographer under IR(ME)R. Within this environment, the CT radiographer must ensure they maintain the skills required for appropriate utilisation and management of available techniques. An aptitude to pre-empt and avoid non-intended outcomes is key to safe scanning.

It is crucial to be able to maintain high levels of concentration in sometimes physically and emotionally challenging conditions. The radiographer should ensure the working environment is as free from distraction as possible. Recognition and identification of abnormality are skills that improve with experience. While these abilities are developing, the CT radiographer is encouraged to seek appropriate advice regarding the need for additional information.

Regulations and further guidance is available on the SCoR website: https://www.sor.org/practice/radiation-protection

4.4 Patient-centred care

As previously described, the CT radiographer may be involved in each step of the patient pathway including receiving the referral and justifying or authorising the examination, carrying out the exposure, issuing the results and recommending further investigations or follow up care. At this level of practice, they are likely to be more influential in streamlining patient care.

Patients attend for a CT scan by appointment from home or another healthcare environment, or as an in-patient. As well as the condition under investigation, patients may have other specific needs such as mobility or learning difficulties. They may have visual or hearing impairment, language problems, brain injury, dementia, or social or psychological problems. Patients will have variable understanding and expectations of the procedure and can come from diverse cultural backgrounds. The radiographer must have the ability to work flexibly and provide individually personalised and compassionate care.

Patients may be unware of their potential diagnosis. Radiographers must be mindful of different emotions and behaviours expressed due to uncertainty, fear and anxiety relating to the scan and the results. A CT scan takes longer to perform than an x-ray. A successful, skilled CT radiographer will earn the confidence of the patient in order to establish their consent and compliance.

Very sick and critically ill patients benefit from CT scans. They are required to travel from a relatively safe environment to the scanner. Emergency department physicians, nurses, surgeons and anaesthetists may accompany these patients. The radiographer needs effective communication skills

in this multidisciplinary environment. Patients often have to travel while attached to multiple intravenous infusions, they may be immobilised due to injury or have their breathing supported by mechanical ventilation. The CT radiographer must prioritise the timely production of optimum quality images while supporting the team concerned with the intensive care needs of the patient.

4.5 Leadership and teamwork

The jointly published “Team working in Clinical Imaging” document[24] details the shared views of the SCoR and the Royal College of Radiologists (RCR).

Radiographers work in CT either as a dedicated member of a specialist team or on a rotational basis. In both cases, it is recommended that there is a core of permanent, experienced senior staff to safeguard standards of training and promote excellence. Effective CT leadership will align technological advancements with staff development to enable the delivery of value-based care through innovation, collaboration and succession planning.

CT radiographers must embrace teamwork and recognise diversity within the team. They should be experts in efficiency but be able to distinguish this from speed in order to work safely. They should embrace inter-professional working, founded on common respect and reflecting an overarching organisational culture of care and compassion for all staff.

An effective CT team has a common ethos and shared objectives. Radiographers should be instrumental in leading change, be able to adapt to evolving needs in the healthcare environment and be proactive in identifying issues and raising concerns when necessary. The CT radiographer must ensure each examination is performed for the right patient, in the right place and at the right time. In doing so, they become integral to the outcome of the patient experience and to the effective service delivery for the wider community.

The CT radiographer must possess the confidence to challenge decisions they do not consider are in the best interest of the patient. Regular reviews of practice and processes are fundamental to safe service delivery and good governance. Equipment should be fit for purpose. The radiographer is duty bound to raise concern if an individual, process or product is perceived to be failing.

5.0 Advanced Practice and Role Extension

CT is a diagnostic pathway well placed to facilitate and benefit from advanced and consultant level practice. Expert specialist clinical knowledge is supported by leadership, research, service development and educational skills and is benchmarked by the CoR accreditation schemes. The SCoR Education and Career Framework document[25] stipulates the learning outcomes radiographers need to achieve.

Examples of role extension in advanced and consultant practice include:

5.1 Virtual colonoscopy

NICE supports CT colonography (virtual colonoscopy) as an alternative to colonoscopy or flexible sigmoidoscopy then barium enema for some patients.[26] When performed by specialist trained CT radiographers it provides an opportunity to allow rapid completion of staging at one visit without the requirement to have a radiologist present. The benefits of this type of radiographer-led service include reduced wait for results, potentially lower costs and improved patient experience.

5.2 CT head reporting

CT Head reporting by radiographers has evolved over the past 10-15 years. Advanced practitioner radiographers may be involved with clinical leadership and education, scanning, reporting and

research within their area of expertise and so offer unique insight and opportunity to lead service redesign and delivery. Postgraduate training is mandatory to achieve a Certificate in Reporting. In addition to this, specific Scope of Practice and Scheme of Work documents should reflect this hybrid role and be agreed and signed off by employer and employee.

6.0 Research

The HCPC demands that radiographers engage in evidence-based practice. Research is fundamental to improvements in education and service delivery, patient care, technological innovations, education, and development of the workforce. he College of Radiographers (CoR) expects all radiographers to be engaged in research. It is one of the four pillars of advanced and consultant level practice. The CoR has developed a research strategy[27] which sets out key patient-focussed research priorities.[28]

7.0 Summary

The role of the radiographer in CT is autonomous and multifaceted. It demands awareness of, and adherence to, national legislation, professional guidance and local policy. It requires possession of specific skill sets and excellent anatomical, physiological and radiographic knowledge. It encourages critical thinking and experiential-based development. It necessitates team ethics and shared objectives. Its focus is to deliver a safe, high quality, compassionate and effective patient experience.

Radiographers working in CT add value, breadth and diversity to the multidisciplinary team and are encouraged and supported by the CoR to develop accredited advanced and consultant-level practice via the CPD Now platform.[29] This can only be achieved through effective teamwork which is enhanced by all members working at the top of their skill sets.

The continuing development of technology and the growing range of clinical applications in CT suggest that individual and population dose from CT will continue to rise. It is imperative therefore, that safe staffing considerations are paramount in the commissioning, planning and delivery of CT services in order to deliver the National Quality Board agenda of the right staff, with the right skills, in the right place at the right time.[30]

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