The life of a CT interventional radiographer

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Introduction

The number of CT interventional procedures has increased over the years due to its availability, superior visualisation and ease of use.[1] Interventional procedures in CT use an array of complex instruments, and advancing medical technology is used to support consultant radiologists during interventional studies. This leaves little to no room for error. To manage and meet these challenges, a highly skilled radiographer is required, one who understands the complexity of the procedures and directs the imaging safely and efficiently.

During CT interventional procedures, the range of equipment used for diagnostic or therapeutic procedures requires a skilled team of healthcare professionals including consultant radiologist, radiographer, theatre nursing staff, consultant anaesthetic doctor, operational department practitioner, porter and recovery nurse. Patient safety and care are the responsibility of the consultant radiologist and the consultant anaesthetist during procedures, while the radiographer is primarily responsible for the radiation safety of the patient and the staff involved in the procedure, in addition to providing the required images.

Interventional radiography

A wide range of techniques and procedures that use radiological image guidance such as x-ray fluoroscopy, CT, ultrasound or MRI to accurately target therapy is known as interventional radiography. The procedures performed using interventional radiography start with passing a needle through the skin to the target.[2] These minimally invasive procedures are alternatives to laparoscopic and open surgery.

CT interventional procedures

CT interventional procedures are now widely used for diagnostic and therapeutic purposes to substitute surgery. This is because the procedures are more cost-effective and less invasive than open surgery.[4] Images in 2D and 3D are acquired during the procedure to create a roadmap of the lesions and their position in relation to the interventional instruments. The 2D and 3D roadmap guides the radiologist to locate, plan and adjust the instruments to the lesions effectively.

The interventional procedures performed at The Royal Orthopaedic Hospital include biopsy, CT-guided injection, CT aspiration, vertebroplasty, CT ablation and cryotherapy. A biopsy entails the insertion of a device into the target lesion and a biopsy (a small section of tissue) is taken for histologic analysis; injection is a procedure whereby a needle is inserted into a target and a therapeutic agent is injected; aspiration is a similar procedure to biopsy, but takes out a sample of fluid for histologic analysis; vertebroplasty is the deposition of stabilising bone cement into a target to augment the vertebral bodies that are fractured or osteoporotic;[3] CT ablations are procedures that introduce high frequency electrical currents (heat) through a needle-like probe and guided by CT imaging to destroy identified lesions; cryotherapy is the controlled insertion of argon gas into adjacent tissues of a target to cool it through probes. In cryotherapy the systematic process of the thermal conduction pathway will transfer the cold and freeze the target organ. Numerous freeze-thaw cycles are done to ensure the target or tumour is completely frozen (destroyed).[5]

Real-time reconstruction of the data acquired during the procedure provides immediate feedback to the radiologist, which is helpful for most interventional studies. CT demonstrates three-dimensional planes: coronal, sagittal and axial. The advantage of having the sagittal and coronal planes is that we can monitor the traction and placement of the needle in relation to surrounding anatomy and the direction of the needle from the different planes. This helps the radiologist perform the biopsy or injection more quickly than with other modalities that can only show the anatomy on one plane. This ensures that the procedures are minimally invasive, short and have an accurate path to the lesion. The procedures also ensure the patient is treated earlier and receives a more effective interventional diagnosis.

Role of the CT radiographer

The CT radiographer must have a combination of radiographic, clinical and technical skills. These skills are required to be able to assess situations quickly and to promptly mitigate any challenges, in order to ensure the safety of patients and staff from unnecessary radiation exposure.

The CT radiographer performs many duties during an interventional procedure, but their main responsibility and role is in regards to the optimisation of radiation use and patient safety.[6] The radiographer advises on the use of the CT system, performs quality assurance (QA) on the machine, and provides the imaging to assist the radiologist during the procedure. During interventional procedures, the radiographer provides the real-time reconstruction of the scans to guide the radiologist for an accurate path to the lesion. It is the responsibility of the radiographer to ensure the images produced are of optimal quality with good spatial resolution and minimal noise. This supports the radiologist in being able to distinguish the different anatomies during needle alignment in a procedure.

Other responsibilities of the radiographer include ensuring that all the equipment required for a procedure is available and in working order, and making sure all the appropriate documentation is readily available for each patient. The radiographer also ensures that the argon gas used during cryotherapy is readily available and stored appropriately. This is achieved by liaising with the porters to ensure the safe delivery of the required argon gas in a timely and effective manner. Also, the radiographer reports and troubleshoots any equipment issues as and when they arise to try and minimise any disruption to service delivery, with patient and staff safety in mind. During the interventional procedure, if there are any additional emergency ad hoc non-interventional cases that need scanning, this must be agreed with the consultant radiologist before acceptance.

After each interventional procedure the radiographer sends all the images acquired to PACS, confirms the arrival of images to PACS, completes post processing on CRIS, scans all the relevant documents and records any unexpected events on CRIS. The radiographer then ensures the interventional equipment (iController, footswitch etc) is put back at its appropriate docking point and attached to charge to be ready for the next patient. The radiographer assists with patient transfer from the CT scanner to ensure the transfer is safe both for the patient and the scanner.

Preparations

As a CT interventional radiographer, there are a few preparations to be completed before the start of the day's list and before each patient. The radiographer switches on the CT scanner at the beginning of the day and performs warm-up protocol as well as QA, ensures the CT scanner is set up with interventional equipment (iController, footswitch etc) and is working optimally. The iController is a wireless control joystick, which provides full control of the table and user interface and enables the radiologist to work independently in the scan room when scrubbed during a procedure. Other equipment required such as the argon gases need to be checked they are readily available and full. The biopsy needles, vetebroplasty kit and contrast medium are also checked they are readily available and within date.

Prior to the start of a CT interventional list the consultant radiologist and consultant anaesthetist consent all patients booked for the day in the admission unit or patient wards.

Every patient booked for an interventional case will be checked in by theatre staff, and a World Health Organization (WHO) check is performed by the team. The WHO check is performed first thing in the morning just before the team brief, so that all team members introduce themselves and familiarise themselves with the order of the list and any patient, or organisational concerns are shared before commencing the list. Patient position, condition and requirements are discussed and shared with the team so everyone can be adequately prepared for each patient as and when they present for their procedure.

Before the patient arrives in CT, they would have undergone extensive pre-operative and admission checks. Final patient checks are performed in the CT room with the team present, including the radiographer, to check patient identification and that the correct site and laterality of interest is marked as agreed against the informed consent. Any other checks, such as allergies and pregnancy status, are double checked at this stage with the patient.

Female patients within childbearing age would have their last menstrual period (LMP) checked by the radiographer to ensure it is within the 10-day rule. Problems arise if a pregnancy test has not been performed or the LMP form not filled out properly. This is why it is essential for the radiographer to check pregnancy status before the patient has been anaesthetised or sedated, especially if the patient is of childbearing age as defined by IR(ME)R and locally agreed protocols. Failure to exclude pregnancy could result in the patient's procedure being cancelled from a radiation protection and patient safety perspective.

Due to COVID-19 restrictions, most of the interventional procedures require and include a negative COVID-19 test within a specified time period and an isolation period for almost all patients before presenting to the hospital for their intervention study. Appropriate personal protective equipment is used for all patients.

If, for any reason, the patient missed their COVID-19 isolation period, then further precautions are in place. Otherwise, a COVID-19 test on the day of admission is obtained.

Expectations and challenges

In CT interventional studies, there are high expectations by the radiologist and other healthcare professionals of the radiographer: the radiologist relies on the radiographer to ensure the machine with the interventional equipment is functioning optimally; provision of images along with 3D reconstruction during procedures; mitigation on complicated cases such as reducing the range on the area to be scanned during cryotherapy block scans to reduce the radiation dose to the patient; during morning preparations by the radiographer if it is noticed that the iController switch is not working the radiographer would have to scroll through images, measure the depth of lesion point and zoom to the lesion; any equipment failure will require prompt thinking to ensure there is no cancellation of the interventional list.

There are many challenges the CT radiographer faces during an interventional day and they all differ in aspect. An example of such is when last-minute ad hoc CT scans agreed by the radiologist to be performed at some point during the interventional list require the radiographer to negotiate the best time or window of opportunity to scan the patient without disrupting the interventional list. This can be challenging for the radiographer and creates a sense of pressure to prioritise between the added scan and the interventional procedures. Thus, the radiographer would have to prioritise and collaborate with the other healthcare professionals to scan the patient. Examples of urgent additional scans are urgent pre-operation patient scans and outpatient and inpatient ad hoc examinations. The radiographer would have to consider the hospital COVID-19 rules of not mixing outpatients (COVID non-clean) and inpatients (COVID clean) when prioritising the ad hoc examinations.

The other healthcare professionals expect the radiographer to inform them when it is safe to go into the CT room during a procedure to perform their duties for the patient. Essentially, the radiographer plays an integral part during CT-guided interventional studies. Their role ensures good teamwork between theatre staff and the radiology team and also ensures smooth running of the interventional list including, but not limited to, radiation protection for all involved. Their role is essential for effective service delivery and good quality experience for the patients involved.

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