



THE HEART

REVEALED

RADIOLOGY IN THE DIAGNOSIS AND
MANAGEMENT OF CARDIAC CONDITIONS

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THE ROLE OF RADIOGRAPHERS IN OTHER AREAS OF CARDIAC IMAGING

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INTRODUCTION

The cardiac catheterisation laboratory is one of the most unique medical environments in existence today. Also known as the 'cath lab', it is where a multidisciplinary team diagnoses and treats congenital and acquired heart disease. Since the emergence of the cath lab in the 1980s, the use of percutaneous intervention, a minimally invasive procedure that uses only small incisions to access the heart, has grown exponentially. With rapidly evolving technology and expanding indications, percutaneous transluminal coronary angioplasty (PTCA) has grown to equal stature with coronary artery bypass grafting as the number of annual PTCA procedures grew to 300,000 in 1990¹. Today, coronary angioplasty is performed on more than 2 million patients in the world annually². And from the beginning, the radiographer has played a fundamental role in the multi-professional teams who treat patients with life and limb threatening diseases. Contributing far more than an expertise in imaging, today's cath lab radiographer has accepted the challenge of rapidly developing technology and the incredible procedures they enable.

HISTORY

The cath lab has come a long way since 1929 when Nobel Prize winner Werner Forssmann performed the first cardiac catheterisation on himself. Under local anaesthesia, Forssmann inserted a catheter into a vein in his arm. Not knowing if the catheter might pierce a vein, he walked downstairs to the x-ray department where, under the guidance of a fluoroscope, he advanced the catheter 65cm into his right ventricular cavity³. Medical imaging and invasive cardiology have been inseparable ever since.

CATH LAB RADIOGRAPHER

Radiographers specialising in the cath lab possess a broad knowledge base and refined psychomotor skills. However, the cath lab radiographer's responsibilities are unique and extend far beyond that of medical imaging. A cath lab radiographer is a multi-talented professional who literally works side-by-side with cardiologists. Radiographers share the knowledge and skills necessary to assist in a collection of increasingly sophisticated procedures. Lifesaving procedures often create an environment of high stress and emotion, and the cath lab radiographer demonstrates poise and a level of composure not common among other medical imaging professionals. The anxiety of the patient during these life-changing procedures is well documented^{4,5} and is associated with worse outcomes in coronary artery disease patients. Fortunately, the European Federation of Radiographer Societies (EFRS) Level

6 radiographer is well prepared to "appraise the needs of patients and exercise sound clinical reasoning skills in order to provide appropriate, holistic and context-specific care in a broad range of situations within the clinical setting"⁶.

Working under the guidance of a licensed physician, the cath lab radiographer:

- performs or reviews a baseline patient assessment
- evaluates patient response to diagnostic or interventional manoeuvres and medications
- provides patient care and often drug administration commonly used in the cardiac catheterisation laboratory
- provides procedural (scrub) assistance
- operates all imaging technology
- performs physiologic monitoring and case documentation
- performs pre-cardiac and post-cardiac patient care activities and procedures
- contributes to the cath lab team's efforts to provide emotional support prior to, during and after the procedure

The radiographer also coordinates access to supporting imaging such as computed tomography and ensures the availability of a wide range of equipment ensuring diagnostic and interventional procedures are carried out with optimum efficiency.

The modern cath lab employs an array of imaging technology, all of which must be mastered by the radiographer. Intravascular ultrasound (IVUS) and optical coherence tomography (OCT) provide detailed images and critical information necessary for accurate vascular assessment. As a procedural assistant, the radiographer displays an exceptional knowledge of the preparation and use of wires, balloon catheters, stents and a myriad of other devices. The radiographer employs not only their knowledge but also their skills to ensure optimum outcomes. In addition to the cardiac cath lab, you will also find radiographers assisting with procedures in interventional radiology, paediatrics, neurology and electrophysiology.

MULTIDISCIPLINARY PRACTICE

The increasingly complex procedures of the cath lab require highly coordinated multidisciplinary teams. Recent developments in cardiac surgery and interventional cardiology and new percutaneous alternatives have led to the creation of integrated, hybrid cath lab/operating rooms that enable both surgical and intravascular procedures. The radiographer works with a team of professionals including cardiologists, cardiac surgeons, sonographers, vascular surgeons, anaesthesiologists, engineers and nurses. There is mutual trust in the cath lab and an expectation that each member excels in their area of expertise for the benefit of the patient. The cath lab team performs

their tasks with efficiency and precision, moving about the cath lab in a well-choreographed routine. And although the radiographer is associated mainly with their expertise in medical imaging skills, they are a vital member of the cath lab team and contribute to all phases of patient care.

CATH LAB PROCEDURES

The minimally invasive treatment that continues to define the cardiac cath lab is angioplasty and the use of coronary stents. Arteries once thought to be forever occluded are now being restored with sophisticated techniques enabled by novel technology. For a great number of patients, a procedure in the cath lab is a welcome alternative to coronary artery bypass surgery. However, in recent years there have been striking advancements in the number of procedures that the cath lab offers as an alternative to surgery. It has been predicted that 50% of the financial return from cardiac cath labs will be from non-coronary procedures by 2020⁷. Heart valve repairs and replacements, left atrial appendage (LAA) occlusions, heart failure interventional device therapies, closures of atrial septal defects (ASDs) and ventricular septal defects (VSDs) and patent foramen ovale (PFOs) can all be treated in the cath lab.

There are many new interventional technologies on the horizon. However, these procedures are only possible with the application of ionising radiation. Radiation dose has been associated with an additional risk

of developing radiation-induced cancer and cataracts for medical staff, and there is the potential for cancer and tissue reactions (erythema, dermal atrophy, and ulcers) for patients. Although increasingly complex procedures demand longer fluoroscopy time, cineradiography time or both⁸, innovative technologic advancements and diligent adherence to best practices have greatly reduced the radiation dose to patients and operators. The radiographer plays a central role in ensuring the proper use of radiation protection tools and techniques ensure that the radiation doses to patients and staff are as low as possible.

RADIATION SAFETY ADVOCATE

Radiographers are specifically trained to operate medical imaging equipment in a manner that optimises image quality and minimises patient and clinical personnel exposure. ALARA stands for 'as low as reasonably achievable'. This fundamental principle of radiation protection is taught to radiographers on their first day. It is the primary goal of all radiographers, but there are few places where this principle is more important than the cath lab. Radiation exposure to patients in diagnostic and interventional procedures has been estimated to be hundreds to a thousand times more than a chest radiograph⁹. It is the radiographer who is educationally prepared and clinically competent to ensure that not only the patient's but the entire cath lab team's exposure is 'as low as reasonably achievable'.

CATH LAB RADIOGRAPHER TRAINING

It takes many years for a radiographer to become astute in this clinically complex environment. Radiographers who perform medical imaging examinations have met stringent educational and credentialing standards. The Education Qualifications Framework Level 6 published by the EFRS and the International Society of Radiographers and Radiological Technologists (ISRRT) defines the core knowledge, skills, and competences that enable the radiographer to contribute to the care of the patient⁶. Today's cath lab radiographer is equipped with knowledge of radiation physics, radiation biology, x-ray image formation, and the operation of an x-ray cinefluorographic unit.

The radiographer is responsible for understanding each level of complexity relative to radiation safety, cardiac anatomy, physiology, and haemodynamics, and the technical aspects of all the equipment utilised during any cardiac or vascular procedure. They are masters of the delicate interplay of technology and anatomy that is required to achieve optimum outcomes. The competent radiological technologist is informed about current modifications and advances in procedures, as well as developments in the industry itself.

To keep pace with new and increasingly sophisticated procedures, the cath lab radiographer commits to a career-long continuing educational process. The EFRS recommends lifelong learning for all radiographers to support service and personal development. Continuous Professional Development (CPD) is defined as "the continuous learning

process required to maintain, develop and improve one's knowledge, skills and competences to work effectively and safely"¹⁰.

Credentialing in this healthcare setting has grown proportionally to the new forms of treatment that are enabled by advancing technologies. Many of these specialties and subspecialties have national and international exams which healthcare workers can pursue. This is also true in the cath lab. The Registered Cardiovascular Invasive Specialist¹¹ is one example of a credential earned by cath lab radiographers around the world. In addition to their radiography training, the cath lab radiographer often seeks credentials in sonography, electrophysiology and a growing list of other areas. The cath lab radiographer who earns these secondary credentials demonstrates not only fundamental knowledge but also a dedication to their professional development.

THE FUTURE

Mortality from myocardial infarction has dropped dramatically – by 80% since the 1950s – due to technological advancements, and the cath lab has contributed to that success¹². Future technology capability will enable more sophisticated procedures, improving patient and operator safety, and expand the use of minimally invasive cardiovascular procedures into areas that were previously only the domain of surgeons. The fusion of x-ray and MRI/CTA are already changing the way catheterisations are performed on patients with cardiovascular disease. Radiographers will soon be

performing advanced 3-D imaging to facilitate more accurate navigation inside vessels and device placement. Advanced visualisation will include free-floating and 3-D holographic images, and robotic systems for peripheral, coronary and electrophysiology procedures will soon become standard practice in the cath lab. Ionising radiation could soon be eliminated from the cath lab as the use of MRI image guidance replaces x-ray based imaging. The ability to visualise all the patient's anatomy, not just an x-ray of unblocked coronary artery lumens, holds tremendous potential.

From the first cardiac catheterisation, when Werner Forssmann walked to the x-ray department to confirm the placement of a catheter in his arm, to the use of sophisticated three-dimensional imaging to replace valves in a heart, the radiographer has contributed to the diagnosis and treatment of millions of patients.

CONCLUSION

This chapter attempts to demonstrate the rapidly evolving role of the radiographer. Although the challenges are many, with the support and guidance of the EFRS and ISRRT and an unwavering dedication to patient care, the radiographer will continue to make significant contributions to the cardiovascular care team.

References

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