

# Perspectives from Human Interventional Radiology

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## KEYWORDS

• Interventional radiology • Radiograph • Stenosis • X-ray imaging

## KEY POINTS

- Interventional radiology is a subspecialty of diagnostic radiology that uses minimally invasive techniques performed under imaging guidance.
- Numerous medical scientists and physician-scientists have played important roles in the advancement of human interventional radiology, and their discoveries and thought processes served as the foundations for innovative procedures that subsequently developed within veterinary medicine.
- Image-guided minimally invasive procedures have been used to treat myriad conditions and solve innumerable therapeutic puzzles for human patients since the 1960s, but the field nonetheless continues to evolve and adapt at an incredible pace.
- Going forward, the collaboration between human and veterinary interventional radiologists will persist as a two-way street, and we will continue to innovate together and learn from each other and from our patients.

Interventional radiology is a subspecialty of diagnostic radiology that uses minimally invasive techniques performed under imaging guidance. Although it is sometimes referred to as image-guided surgery, most procedures performed by interventional radiologists use skin incisions that are less than 5 mm in length. In human patients, most of the procedures are performed using local anesthetic only or local anesthesia combined with moderate sedation. General anesthesia is rarely necessary. Recovery time from these procedures is typically short, and up to 80% can be performed on an outpatient basis, with patients going home the same day.

Interventional radiology has its roots in angiography, which is the radiologic examination of blood vessels after the introduction of a contrast medium that allows them to be imaged. The first angiogram was performed only months after radiographs were discovered by German physicist Wilhelm Roentgen in 1895. Two physicians in Vienna injected mercury salts into an amputated hand from a cadaver and created an image of the arteries in January, 1896. Egas Moniz, a Portuguese physician, developed the technique for use in living human subjects and performed the first cerebral angiogram

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in 1927. By the 1930s, angiography became the first interventional radiology procedure performed in human subjects for diagnostic purposes.<sup>1</sup>

In 1953, Dr Sven Ivar Seldinger described a technique that enhanced the safety of angiography. Before his work, large bore needles were used to access arteries, and liquid radiopaque contrast was either injected directly for x-ray imaging or a smaller catheter was placed via the needle into the blood vessel and used for the contrast injection. Because of the large size of the necessary instruments for this technique, it could only be used to access large diameter blood vessels such as the aorta. Also, because it created a large hole in the artery on removal of the instruments, hemorrhage and arterial wall injury were frequent complications. Seldinger refined the procedure by placing a flexible guidewire through the needle after vascular access. The needle was removed, leaving the guidewire behind as a placeholder that bridged the space between the skin surface and the blood vessel lumen. Then, a thin-walled, flexible plastic catheter was threaded over the wire and placed percutaneously into the blood vessel.<sup>2</sup>

Seldinger's method was a very important enhancement in radiologic technique, because it allowed a catheter of similar diameter to the original access needle to be inserted through the skin to the vessel below, obviating the need for a large bore needle or surgical exposure of the vessel. Smaller vessels could be used, including ones that were more superficial than the aorta. In the 1960s, femoral access became popular, because the femoral artery was superficial, palpable, and located anterior to the femoral head, which allowed for manual compression to achieve hemostasis following removal of the catheter. This technique ultimately allowed the field of interventional radiology to take root and grow. It was found to be useful not only for accessing blood vessels but also, in subsequent years, for obtaining percutaneous access to a variety of anatomic structures, including bile ducts, urinary collecting systems, stomach and bowel, lymphatics, and others.

Not long after Seldinger developed his technique, Charles T. Dotter became the chairman of the department of radiology at the University of Oregon. He was only 32 years of age when he took this post, and it was a position he held for over 30 years. He was known for being a brilliant innovator with tireless energy and an outspoken, flamboyant, and animated style. He is generally regarded as the father of interventional radiology. He invented several important devices, including Teflon catheters and flexible guidewires, and also developed rapid sequence film technology that allowed for improved diagnostic evaluation of arteries. Dotter was the first to perform percutaneous transluminal angioplasty to treat stenosis of an artery and published a paper describing the technique in 1964.<sup>3</sup> Of interest, the original angioplasty procedures that he performed did not make use of angioplasty balloons, which had not yet been invented for percutaneous use, but instead used multiple dilators of progressively larger size, placed over a guidewire and through the stenotic area to stretch it open. He subsequently went on to introduce arterial stenting and stent graft placement, as well as thrombolysis to dissolve blood clots using direct injection of streptokinase into the thrombus occluding the vessel. He also helped develop the loop snare, used to retrieve intravascular foreign bodies.<sup>4</sup>

In 1974, Andreas Gruntzig, a cardiologist in Switzerland, invented a balloon catheter for dilating vascular stenosis.<sup>5</sup> Melvin Judkins developed preshaped catheters that readily allow for coronary artery catheterization. Although interventional radiologists were instrumental in creating many of the original techniques and devices used in coronary angiography and interventions, interventional cardiology eventually branched off from interventional radiology and became a subspecialty of cardiology.

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