Interventional Equipment and Radiation Safety

Andréanne Cléroux, DMV[a,*], Rebecca Hersh-Boyle, DVM[b], Dana L. Clarke, VMD[c]

KEYWORDS

• Radiation • Fluoroscopy • Catheterization • Balloon dilation • Embolization • Stent • Interventional radiology

KEY POINTS

- Veterinary interventional radiology was adapted from techniques developed in human medicine, and has a variety of applications to treat disease in multiple organ systems.
- Fluoroscopy is required for most interventional procedures, requiring knowledge of proper safety techniques for working with ionizing radiation.
- There are a wide variety of catheters, wires, sheaths, stents, and embolics used in veterinary medicine. Familiarity with their indications and sizing compatibility is essential for procedural success.

INTRODUCTION

Interventional radiology (IR) is a specialty that was first developed in human medicine and that uses minimally invasive image-guided techniques to allow the diagnosis and/or treatment of a variety of conditions. In its infancy, it consisted only of diagnostic procedures, mainly angiography for cases such as neoplasia, gastrointestinal (GI) bleeding, deep vein thromboembolic disease, and vascular mapping before a surgical intervention.[1] Before the advent of IR, these procedures were only possible with the placement of catheters via surgical cutdowns.[2] In 1953, Dr. Sven Seldinger[3] described percutaneous vascular catheter placement following needle access, later named the Seldinger method, which laid the foundation for the development of IR. Shortly after, Dotter and Judkins,[4] using the Seldinger method to establish vascular access, described the transluminal treatment of arteriosclerotic obstructions using a guide and dilating catheters under fluoroscopic guidance, minimizing the limitations associated with the surgical correction of this condition, surgical trauma, and morbidity. This was a key step in

[a] Department of Clinical Sciences and Advanced Medicine, University of Pennsylvania, School of Veterinary Medicine, 3900 Spruce Street, Philadelphia, PA 19104, USA; [b] Department of Radiological and Surgical Sciences, University of California, Davis, School of Veterinary Medicine, 1 Shields Avenue, Davis, CA 95616, USA; [c] Department of Clinical Sciences and Advanced Medicine, University of Pennsylvania, Philadelphia, PA 19104, USA
* Corresponding author.
E-mail address: clea@upenn.edu

Vet Clin Small Anim 48 (2018) 751–763
https://doi.org/10.1016/j.cvsm.2018.05.009
vetsmall.theclinics.com

the development of minimally invasive therapeutic interventions and led to the creation of IR. This specialty has since grown at an exponential rate, owing to the expertise developed and advances in imaging modalities, techniques, and instrumentation.

The specialty of veterinary IR was more recently developed, applying techniques initially described in human medicine. In 2005, the first IR service was established by Dr. Chick Weisse at School of Veterinary Meicine of the University of Pennsylvania.[5] Since that time, innumerous advances have been made in this specialty, allowing the development of techniques and instrumentation, as well as an expanding number of conditions amenable to minimally invasive treatment and correction. Veterinary IR diagnostic and therapeutic procedures are performed by highly trained specialists and require proper equipment and knowledge of basic instrumentation. This article describes the equipment and techniques commonly used in veterinary IR. A more comprehensive description is available elsewhere.[6,7]

EQUIPMENT

Digital Fluoroscopy

The use of digital fluoroscopy is essential for most procedures performed in veterinary IR. Mobile C-arm digital fluoroscopy systems are used in most veterinary hospitals. Newer generations of C-arm units include the latest technology, such as flat-panel thin-film-transistor arrays, offering greater capabilities and image quality, while reducing radiation exposure. Most of these newer units are also floor- or ceiling-mounted, enabling effortless manipulations to get various projection angles. Digital fluoroscopy permits rapid acquisition of x-ray–based images as an analog video signal, which is then converted into a digital format and real-time images are projected into a monitor.[8] The images obtained can be manipulated in several ways, with digital fluoroscopy offering features such as digital subtraction angiography (DSA), road mapping, and magnification. DSA is a method in which the background of an initial non-contrast image is subtracted from subsequent serial images obtained during contrast injection to enhance the visualization of vessels after opacification with contrast (**Fig. 1**). The quality and diagnostic utility of DSA is greatly

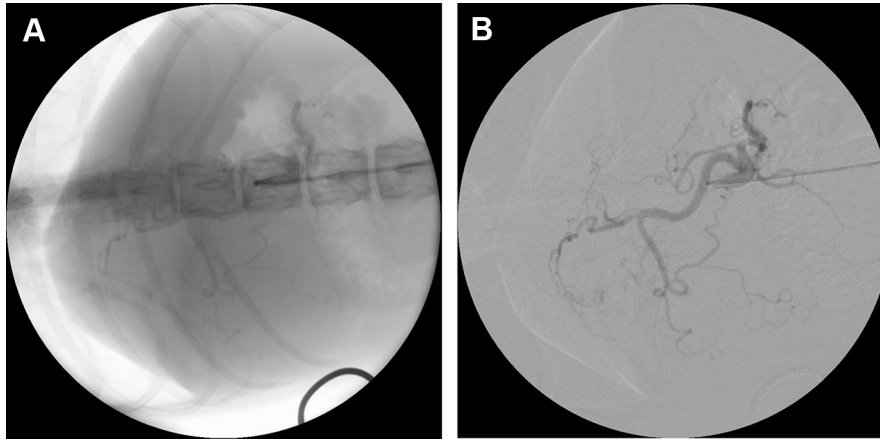

Fig. 1. Angiographic study in a dog. (*A*) Standard angiographic study showing the arterial vascularization of a liver tumor during injection of iodinated contrast medium. (*B*) Same angiographic study showing the arterial vascularization of a liver tumor during injection of iodinated contrast medium in subtraction mode. In this mode the background is subtracted and the visualization of vessels after opacification with contrast is enhanced.