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went into private mixed animal practice in Tasmania, Australia. He returned in 2000 to undertake two concurrent residency programs (Equine Practice and Large Animal Surgery) and then went back to specialist equine private practice in New South Wales, Australia. He became a faculty member at the U of S in 2007.

Emerging technologies tend to be slow in advancing into the equine veterinary arena, typically associated with cost and logistics. This presentation will examine the use of nuclear scintigraphy, computed tomography (CT), magnetic resonance imaging (MRI), digital and computed radiography and ultrasonography in the horse, where we are and where we want to be with these imaging modalities.

Digital and Computed radiography

These advances in radiography have fundamentally changed the way that equine clinicians and their clients view x-rays.

The exposure to potentially harmful chemicals, carefully temperature controlling developing fluids and having to return to the clinic to develop (potentially sub-standard) images is becoming a thing of the past. The difference between computed and digital radiography is in how the image is captured. In the former scenario, the x-rays hit the cassette and interact with a material

which fluoresces. The cassette is subsequently passed through a reader and the image is obtained. In the latter case, the x-rays are sensed by the capture device and each x-ray is detected. Electronics within the capture device (plate) convert this into a digital image which is viewed on a computer screen. Due to the fluorescence of the former technique, a slight blurring of the resultant image can occur, which results in the subtle difference between digital and computed images.

Some clinics trucks are equipped with a cassette reader (if computer radiography is performed), but in some cases, the reader resides in the clinic such that one reader can service both small and large animal branches of the practice. The newest modality (digital radiography) consists of an x-ray generator, a capture device (plate) and a computer (either in the form of a laptop, or in some cases a computer screen mounted on the x-ray generator.

The beauty of the digital radiography system is portability (in some cases, more so than others), the ability to see images on-site next to clients and the patient, as well as the ability to correct exposure or positioning problems without having to return to the patient at another time.

Computed Tomography

This is another x-ray technology-based imaging modality; however, in contrast to radiographs, a cross-sectional image can be obtained. Moreover, the images can be re-formatted to examine the patient in multiple planes and even in 3D.

CT images are generated by an X-ray tube within the CT body, which emits X-rays as it circles the patient within the tunnel. A detector system opposite the x-ray tube collects the images and this data is used to generate an image. There are two general types, either the table moves in coordination with the CT scanner or, in some cases, the table remains stationary while the CT gantry moves over the patient. Obviously, with the standing equine head CT, the latter needs to be the case! With the advent of helical scanning, the patient can be advanced through the tunnel while the gantry rotates and there is no waiting between images. Each x-ray “slice” can vary in thickness from 1- 15mm. Depending on the rotation speed of gantry the speed of image acquisition can be very fast indeed. The limit to equine use is the design of the CT gantry/table combination and also the bose size of the CT machine. Currently at the WCVM, only equine limbs to proximal cannon bone (ie.: not the hock or carpus (knee)) and the head can be imaged using this modality.

CT angiography

Computed tomography angiography (CTA) takes CT technology one step further. In this technique, contrast medium is injected into the patient vasculature and the CT is subsequently used to visualize blood flow. Possible applications of this technology are the assessment of distal limb vasculature after traumatic wounding, as well as using the contrast agent to enhance soft tissue and thereby assess tendons and ligaments. In our institution, this is commonly performed to further delineate soft tissue pain in the foot (typically caudal heel pain) and more recently to assess the size of pituitary masses within the brain of suspected PPID horses (Cushing's disease).

The CT images can be software rendered to give anything from soft tissue to bone and as such are a valuable addition to our pre-surgical planning. This is especially true with complex phalangeal (long and short pastern bone) fractures and in surgery of the equine head.

Nuclear Scintigraphy

"Bone scanning" is not a new technology and has been widely used in equine clinics internationally. The fundamental principle is that a radio-isotope is attached to a radiopharmaceutical (a carrier) and injected into the patient. Depending on what organ or body system you are interested in, the radiopharmaceutical may change. The isotope emits gamma radiation and a gamma camera is used to detect this radiation and build an image as to the location of this source.

The most common use of this imaging modality in the horse is the detection or localization of a complicated lameness. In these cases, 99mTc is injected intravenously, and an immediate vascular (rare), soft tissue (uncommon) or delayed bone phase (common) scan is performed. These are performed standing in a conscious, sedated patient. The acquired images are often compared to a contra-lateral "normal" leg, but in some cases (for example hock disease) the disease process is bilateral. Routine bone scans involve ½ (front or hind) or whole body scans, depending on the localization of the problem by prior clinical examination.

The important limiting factor in the use of this modality is that the outcome gives the clinician (client) a WHERE, not a WHY. For this reason, it is important to use this as part of a lameness examination and clients need to be aware that further diagnostic techniques will be necessary after determining WHERE the problem is so that we can find out WHY the horse is lame.

Ultrasonography

Current equine ultrasound capabilities are incredible. However, as with most imaging

modalities, “you get out what you put in.” This is a combination of both the machine and the imaging specialist. Ultrasound is used frequently in most equine practices, from imaging a 12 day embryo using a rectal scanner, to determining the type and severity of a tendon injury or evaluating an abdomen for colic. Wounds are scanned to look for foreign bodies, bone surfaces can be imaged and show the presence of a bone sequestrum well before it is radiographically apparent and in the case of fracture repair, an infection can be imaged and aseptically sampled by visualizing abnormal fluid adjacent to an orthopedic plate.

Magnetic Resonance Imaging (MRI)

Introduced into human medicine in the early 1980’s MRI is now the “gold standard” for orthopedic and neurological imaging. Live horses were scanned in the late 1990’s and now more than 20,000 horses have been scanned, the majority of which have been for foot pain. There are two types of MRI units, high & low field. This terminology refers to the strength of the magnetic field generated by the machine. The higher the magnet field, the greater the image clarity. The high-field units require that the horse be anaesthetized, however, low-field MRI units are available in which the imaging procedure is performed standing.