

## **Diagnostic Imaging**

### **New technologies mean more accurate diagnoses and more effective treatments**

Liza Holland

The equine industry is seeing more use of a wide variety of diagnostic imaging, particularly with performance animals such as racehorses. Led by some extraordinary advances in technology, veterinarians are able to use these imaging modalities to more accurately diagnose and treat injuries and illnesses.

Veterinarians are finding creative ways to make imaging an integral part of their practices. “We have devoted our entire practice to diagnostic imaging in an interesting partnership with several small animal and equine practices in north Texas,” said Dr. Jake Hersman of Animal Imaging in Irving, Texas. “These individual practices chose to pool their resources to create a state-of-the-art imaging center devoted solely to imaging. All the partners feel like this is a more financially responsible way to provide expensive imaging equipment in a centralized fashion.”

A range of imaging options is now available to veterinarians, including radiography (traditional and digital xrays), fluoroscopy, ultrasonography, video endoscopy, nuclear scintigraphy (bone scan), computer-aided tomography (CT scan), and magnetic resonance imaging (MRI).

Radiography has long been a staple in imaging diagnostics for veterinarians on the racetrack and in clinics. X-rays give a visual of what is going on inside the horse, particularly with the musculoskeletal system. They can be used to diagnose a variety of conditions, such as fractures, abscesses, malformations, and OCD (osteochondritis dissecans, a cartilage disorder characterized by large flaps of cartilage or loose cartilaginous bodies within a joint) lesions. Radiographic equipment used for horses has undergone major developments in the last decade.

Traditional radiography involves the use of film in cartridges upon which the X-rays produce a visible black and white image. In years past, the film developing procedures were lengthy, involving a number of chemicals and several processes. Today, there are rapid automatic film processors that can give results in two minutes, speeding up the time for diagnosis and subsequent treatment.

With digital radiography, practitioners have immediate internal visualizations. Digital radiography today offers high-detail images that can be viewed on a computer screen for analysis, transferred to a radiographic monitor for evaluation and diagnosis, saved to a computer, saved to a disk, or emailed to another practitioner for a second opinion. Much like the individual digital cameras widely used today, the benefits of instant images and the ability to retake images to get a better shot are quite remarkable. The benefit to the patient is significant, because the diagnosis can be done on-site and treatment can commence immediately.

Another technology using X-rays is the fluoroscope. A fluoroscope is a real-time radiographic unit that has a flexible arm. The arm receives the X-rays and connects to a processor with a screen to display the image. It is portable and is used for procedures such as following a needle during joint injection and during surgery to ensure correct placement of implants. The images it produces are not as detailed as traditional radiography, but its real-time imaging and its portability make it a valuable tool for assisting with procedures.

## **ULTRASOUND**

Ultrasonography uses sound waves to produce an image for diagnostic evaluation. The images are formed based upon the varying densities of soft tissue, organs, and bones. The scanners send out sound waves at a frequency rate of 2-15 megahertz. Lower frequencies produce less resolution, but allow the veterinarian to peer deeper into the body; higher resolution offers greater detail to the spatial images, but it can not penetrate as deeply.

There are excellent portable units for use in the field that are used frequently in reproduction medicine to determine pregnancy, reproductive tract fitness, and fetal development. These portable units are limited in their ability to penetrate deeply and for fine detail. Many clinics have more powerful ultrasound units that can scan deep-tissue areas and also offer finer detail for assessing injured areas, abscesses, etc. Ultrasound can be used for assessing the abdominal areas in cases of colic, cardiac evaluation, lung and respiratory tract evaluation, tendon and ligament studies, and more.

Video endoscopy has been used in human medicine for decades, and it is now used extensively in veterinary medicine. Endoscopy is a method of examining the inside of the body using a fiberoptic endoscope. It is an instrument that uses a long, flexible, rubber tube containing fiberoptics that, when combined with a light source, send back to the practitioner a visual picture of the internal structures such as the throat, respiratory tract, gastrointestinal regions, or even joints and the body cavity.

For example, in respiratory work, the scope is typically inserted into the nasal cavity and progresses as far as indicated for the specific diagnostic purpose. There are control knobs on the device that allow the practitioner to move the scope into the precise position needed to make an accurate diagnostic assessment.

Scopes come in a variety of lengths and sizes. A 3-meter-long, 11-mm-diameter scope is typically used for gastrointestinal diagnostics, looking for conditions such as ulcers or hernias. It is also useful for imaging the bladder and intestines. For respiratory diagnostics, a 9-mm-diameter scope that is about one meter in length is preferred, as smaller areas such as the guttural pouches should be examined.

Upper and lower airway conditions in racing Thoroughbreds can have a major impact on performance. Many horses suffer from conditions such as laryngeal hemiplegia (roaring), dorsal displacement of the soft palate, allergies, and exercise-induced pulmonary hemorrhage.

While endoscopes have been commonly used for some time, the addition of video to the technology is relatively new. The video endoscope captures the visuals in a digital form and allows the active video and/or still pictures to be saved and viewed on a computer. This technology is particularly useful in documenting conditions, for education of the client, potential sales use, and consultations. Particularly in the Thoroughbred industry, where horses are being shipped around the world, the video capture allows owners, trainers, and veterinarians the ability to make objective assessments and recommendations without physically being present at the examination- they can consult on cases nationally and internationally.

Veterinarians also value the video endoscope because it can be used to educate clients about a horse's condition and help them better understand the rationale behind the practitioner's treatments.

### **NUCLEAR SCINTIGRAPHY**

A veterinarian conducts a bone scan (called nuclear scintigraphy) by injecting a radioisotope into the bloodstream that is absorbed most fully by areas of increased blood flow, indicating inflammation. Veterinarians can identify areas where soft tissue (such as ligaments)

and bone have suffered damage by noting the areas showing the increased levels of radioactive material. Scintigraphy is also useful in diagnosing bone inflammation where there are no radiographic signs of abnormalities.

Conditions such as navicular disease, early stress fractures, and arthritis can be diagnosed using scintigraphy.

Dental conditions also can be diagnosed with this modality. In addition, it can differentiate between actively inflamed or painful areas versus old injuries that have healed. Scintigraphy does require a larger investment and takes a considerable amount of time to complete (four to five hours). It is typically used in diagnosis of odd lameness that cannot be diagnosed through traditional methods.

## **CT SCAN**

Computer-aided tomography (CT scan, formerly known as CAT scan) is a rotating, focused X-ray beam that is capable of taking “sliced” images of the horse. A CT scan can safely capture images of several portions of the horse. It does this by using multiple X-ray images to develop a composite image, and it can be used in several areas of the horse’s anatomy, including the limbs below the knees and hocks, as well as the head and neck.

At Alamo Pintado Equine Medical Center in Los Olivos, Calif., CT scans have proven “invaluable in evaluating the extent of long bone fractures, the severity of jointing disease, the accuracy of fracture fixation, and a number of other uses within our surgery room,” according to the center’s Web site. “It has also been essential in determining the causes of headshakers and other behavioral problems by providing us with cross-sectional views of the sinuses, tooth roots, temporomandibular joint, skull anatomy, guttural pouches, and even the brain of the horse.

## **MRI**

Magnetic resonance imaging (MRI) has only recently become available to the equine market. It is probably the most expensive of the diagnostic imaging technologies, but it offers many benefits.

MRI provides images of the internal body structures using a combination of magnetism, radio waves, and a computer. An MRI requires that a patient lie on a table that moves. Above the table is a scanner containing a giant circular magnet that creates a strong magnetic field. This field aligns the protons of hydrogen atoms, and then the scanner subjects them to radio waves, which spin the protons. These spinning protons in turn produce a signal detected by the scanner and sent to a computer.

The image the computer produces is highly detailed and can highlight even small changes of the structures within the body. It is particularly valuable in imaging the brain, spinal cord, joints, stomach, and soft tissues. The modality is painless, allows the patient to avoid the risks of radiation exposure during X-rays, and is an extremely accurate diagnostic tool. It can identify small abnormalities in obscure areas that no other technologies mentioned can image. There are no known risks.

“Especially in the case of magnetic resonance imaging, there have been numerous cases where the information learned provided career-saving treatment options to the horse,” said Hersman. “As an example, bone contusions that require four months of rest that may not have ever been afforded that rest prior to the imaging modality being used. It is very beneficial to the horse to understand completely the degree of pathology and institute a definitive course of therapy.”

MRI is an integral tool at Colorado State University's (CSU) Gail Holmes Equine Orthopaedic Research Center. Scientists there report in CSU's research journal that MRI is the "method of choice for assessing the joint tissues and injuries due to its noninvasiveness and the quality of the images produced."

### **COST OF TECHNOLOGY**

So, all of this technology sounds really great, right? It also sounds really expensive. Dr. Nathan Slovis of Hagyard Equine Medical Institute of Lexington helped clarify why it is worth the investment.

"As practitioners, we have traditionally done the basic workup and physical assessments to get an overall picture," he said. "This way, we were usually able to isolate the problem to a certain system or area. Now (with diagnostic imaging), we are able to quantitate it to grade the condition.

"For example, in a horse that has pneumonia, I could hear the crackles, but through the use of digital ultrasound, I can grade the severity on a one to ten scale," he added. "The treatment recommendations come as a direct result of this additional objective information. It also determines the length of treatment. It helps to fine-tune us."

Ultrasound in this case can also help track the progress of the treatment and allow changes to be made quickly if a particular treatment is not working. Knowing exactly what is wrong speeds up the treatment process and gets the horse back to work as quickly as possible. Having an accurate diagnosis and a means of following treatment outcomes mean the right conditions are being treated effectively, which leads to less downtime.

An example offered by Slovis was a case of nasal discharge: "Nasal discharge can come from anywhere- it could be a sinusitis, the guttural pouches might be infected and need to be flushed, or there could be a pharyngitis (throat infection). Video endoscopy can help to further differentiate the type of condition."

The treatment regimen might be different for each of these conditions, so without knowing which one to treat, time could be wasted treating the wrong condition. That lost time might allow the condition to get worse.

Overall, Slovis feels the additional information provided by diagnostic imaging is invaluable for providing accurate diagnosis and treatment. "More information can mean quicker turnaround and lead to less money spent overall," he stated.

It is important to note that even with all these diagnostics available, there are still conditions that elude diagnosis. The body is a complex structure and it can still leave practitioners scratching their heads on occasion.

### **TAKE-HOME MESSAGE**

Diagnostic imaging has had a major impact on the way medicine is practiced in all species. It has made a big difference in the speed and accuracy of diagnosis and treatment, allowing some horses that would have previously been retired to go on to have great racing careers. The bar is continually being raised, and who knows what amazing new technology will be available in the near future.