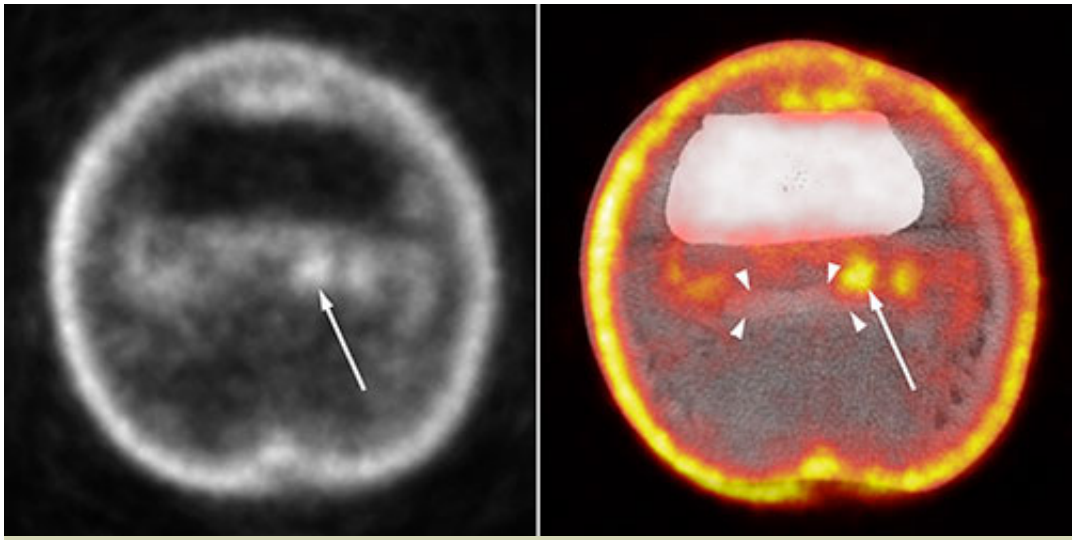
UC DAVIS VETERINARY MEDICINE

News & Events

Breakthrough in Veterinary Diagnostic Imaging: UC Davis Veterinary Radiology Performs First PET Scan on Horse

Background



The image on the left is a transverse PET image through the pastern of the horse. The black area is the short pastern bone (middle phalanx). The arrows indicates focal increased signal in the soft tissue at the back of the pastern. The PET image can be fused to a CT image to confirm the anatomic location of the lesion. The fused imaged (right) confirms that the lesion is on the border of the deep digital flexor tendon (marked with arrow heads).

Equine diagnostic imaging has significantly progressed over the past 20 years with advanced imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) becoming available for horses. With radiography, ultrasound, gamma camera scintigraphy, CT and MRI, the diagnostic imaging tools available for equine patients at specialty veterinary hospitals such as the UC Davis Veterinary Medical Teaching Hospital (VMTH) are similar to what is available to human patients, with one exception: positron emission tomography (PET).

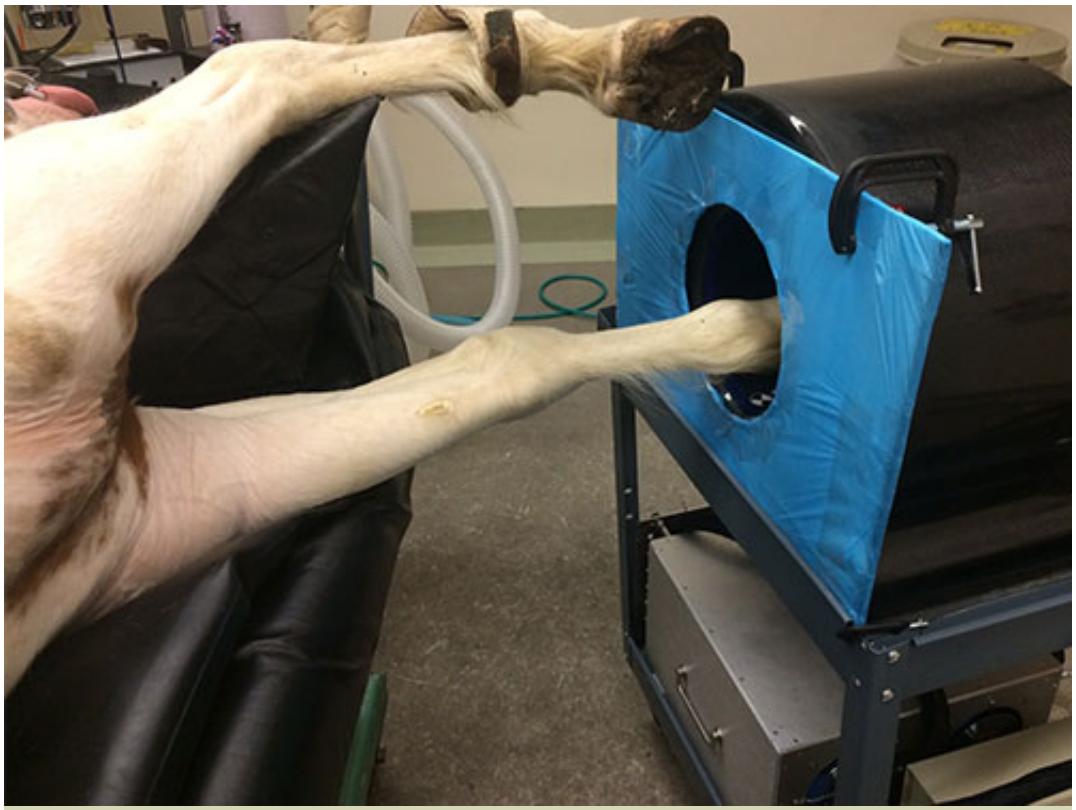
PET is a nuclear medicine technique, which means that, similar to a “bone scan” performed with a gamma camera, a small amount of radioactive substance (radionuclide) coupled to specific markers is injected into the patient. Images are then obtained using a scanner detecting the radioactivity. These imaging techniques are excellent at evaluating functional changes such as area of inflammation, presence of tumors, or areas of bone remodeling. The advantages of PET over gamma camera imaging are the ability to obtain cross-sectional images (slices through the body) and obtain information from both the bones and the soft tissue. In other words, PET is to gamma camera scintigraphy what CT is to radiography.

UC Davis has a reputation of excellence in PET imaging through the team of Dr. Simon Cherry in the College of Biomedical Engineering and through the work of Dr. Ramsey Badawi and

collaborators from the School of Medicine. PET is mostly used in human medicine in oncology for the detection of metastasis and in neurology for functional brain assessment. Recently, the value of PET in the assessment of obscure musculoskeletal pain has also been reported. In veterinary medicine, PET is available at a handful of institutions and is mostly used for oncology in small animals. PET, to this stage, had never been performed on a horse due to logistical challenges related to the size of the equine patient. In the past few years, progress in PET technology has led to the design of a new generation of PET scanners which more compact and more versatile in their applications. Nearly two years ago, Dr. Badawi was the first one to suggest that imaging a horse with a PET scanner would be possible. Since then, Dr. Badawi and Dr. Mathieu Spriet, associate professor of diagnostic imaging at the School of Veterinary Medicine, have worked toward making this project a reality.

Recently, Brain Biosciences, Inc., a leading developer of high-resolution portable PET instruments, temporarily provided a piPET^{TM} PET scanner—a large bore, portable, preclinical PET instrument with 2mm resolution—to UC Davis for use in a VMTH clinical trial focusing on canine brain tumors. Drs. Cherry and Badawi suggested that such a scanner would be appropriate to attempt PET imaging in a horse. Dr. Spriet and David Beylin, Brain Biosciences co-founder, put the project to execution. On April 15, 2015, a UC Davis-owned horse from the UC Davis Center for Equine Health (CEH) was imaged using the piPET^{TM}.

First PET Scan on Horse

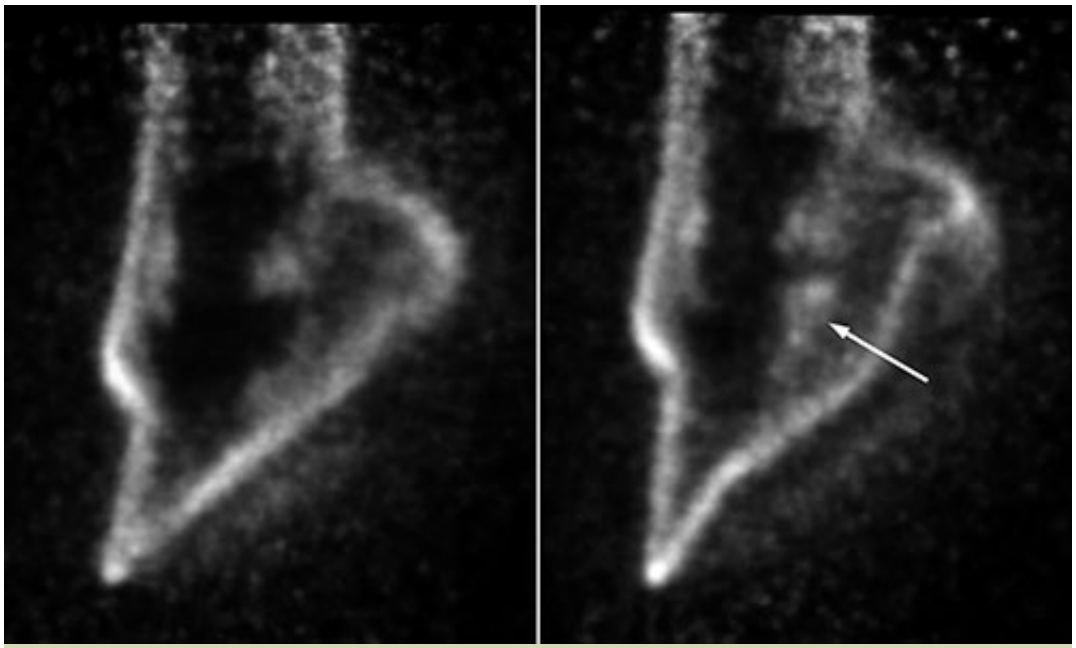


UC Davis veterinary hospital performed the first known PET scan on a horse.

A horse named "Fancy Piece of Candy"—an 18-year-old quarter horse mare known to have a lesion in her left front foot—was selected for the project. The mare was placed under general anesthesia in the VMTH's nuclear medicine room and injected with 35 mCi of ^{18}F-FluoroDeoxyGlucose (F-FDG), the most common radionuclide used in PET imaging. Starting one hour after injection, the feet and fetlocks of both front limbs were imaged. Each site took 15 minutes to image. The mare recovered safely after the imaging procedure. Images were created in three different planes, and the anatomy of the distal limb

could easily be identified. An area of marked increased in radionuclide uptake was identified in the navicular bone of the left front foot, confirming the presence of an active lesion. Additionally, an area of increased uptake was present in the soft tissue at the back of the foot, in the area of one of the major tendons.

Relevance and Future Directions



Sagittal PET images through the foot of the normal (left) and lame (right) limb of the horse. The arrow indicates increased signal in the area of the navicular bone of the lame limb due to the presence of a lesion.

With this first case, Dr. Spriet and Beylin have demonstrated that it is feasible to image horse limbs with a PET scanner. With the dose used, the level of radiation exposure remains reasonable. Lesions can be identified both in bones and soft tissue, and the image quality is far superior to gamma camera imaging. CEH has funded a pilot study that will allow Dr. Spriet to image three more horses in the coming weeks. The completion of this study will contribute to refine the imaging protocol and accumulate data on the appearance of different types of lesions.

More work is needed before the technique becomes available for patients at the VMTH. In the near future, though, it is likely that PET scans will become extremely useful in the investigation of complex lameness cases in the horse. With CT and MRI currently available, the radiologists have excellent tools to detect changes in the size, shape, and density of anatomical structures, but PET will add to this information about the activity at a molecular level. Currently, a challenge following the identification of abnormal findings on CT or MRI is to determine the significance of the lesion. Are the changes chronic and inactive (not contributing to the lameness), or are they active lesions responsible for the clinical signs? PET will help answer these questions.

The ability to assess the level of activity of lesions is also crucial in the follow-up of cases to assess response to treatment and adjust the rehabilitation accordingly in clinical cases. This technique could also have numerous applications in research for better understanding of the pathophysiology at a molecular level and for objective evaluation of response to therapy. Also, PET imaging can be used for the tracking of stem cells. The development of this technology in the horse would be of great interest to the active stem cell research conducted at UC Davis' Veterinary Institute for Regenerative Cures.

The acquisition of the first PET image on a horse is an important breakthrough in veterinary diagnostic imaging. The history behind this achievement is a good illustration of the quality of the research at UC Davis with the power of collaboration between the School of Veterinary Medicine, the School of Medicine, the College of Biomedical Engineering, and private industry. Technical support from the VMTH and logistical support from CEH are also primordial in the success of research programs.