SCINTIGRAPHY

by Domenico Bergero ▮ photos by TuttoArabi Archive

Scintigraphy is one of the most sensitive (albeit less specific) techniques of traditional radiology. It can be of great help in identifying complex problems in humans and animals. For some time now this technique has also been successfully applied to sport horses. Four structures in Italy are already equipped with equine scintigraphy machines.

How it works

Scintigraphy consists in the injection and subsequent localization of a radioisotope or radiopharmaceutical (whose radioactivity is harmless for the animal) binding itself with specific organs or tissues and analyse them determining the presence of a disease.
Among the radioisotope used, worth mentioning are the technetium for bone scanning (and that of mammal glands in humans) and iodine for the thyroid.
When performing a bone scanning, the most frequent type of scintigraphy in horses, the radiopharmaceutical used is Technetium 99m methylene diphosphonate (99m MDP). This molecule emits radiations and has the advantage of providing a good selectivity for bone structures, a rapid excretion and, above all, a fast decay, which makes it safe and easy to handle. The latter characteristic is also important for the protection of the environment, of patients and medical staff using it.
Once the target organ has been reached, the radiations emitted by the isotope show a series of bright spots on the screen of an imaging device placed on the surface of the patient's body. These spots, recorded on a chart (scintigram), "map" the organ or the area that absorbed the isotope.
The pain-free examination starts with the injection of the radioactive product. It is then necessary to wait for some time for the substance to fix on the surface of the target organ; only at that point can the actual examination begin, during which the area is assessed for diseases. The radiation emitted is scanned by the "gamma camera", a device consisting in a detection system and one for processing the data received.
The information contained in the signal is processed

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by a computer and presented as an image or chart. The resulting image will depend on the distribution of the radiopharmaceutical in the body but, most of all, in the tissue to be examined.

What is it for

Thanks to scintigraphy it is possible to detect and visualize an organ showing its anatomical disposition, assess its shape and size and scan for lesions in their early stages (therefore very small) that cannot be detected by other diagnostic systems, determining their location, size and shape. For this reason, this technique is widely used in the study of cancers of certain organs, particularly of some glands (thyroid, suprarenal, pancreas) and of bones but it is also applied to the study of blood, peripheral (arteries and veins) and central circulation (heart).

Scintigraphy in veterinary

Veterinary medicine started to shift its attention towards scintigraphy in the mid-1970s, which led to a development of these studies and applications in this sector. Scintigraphy, especially bone scintigraphy, is currently one of the most useful techniques providing the highest number of new applications for the scan diagnosis of lameness in sport horses.

Traditional radiology identifies a disease by looking at the changes induced in the tissue of a bone. Apart from fractures, the changes to the bone caused by an involution due to an illness or an external cause (presence of tumours, difficult inflow of blood etc.) represent the bone's reaction to the desease and it can take a little while for these changes to become visible through traditional radiology. Bone scans are a diagnostic tool that detects these processes in their early stages and immediately localizes their position.

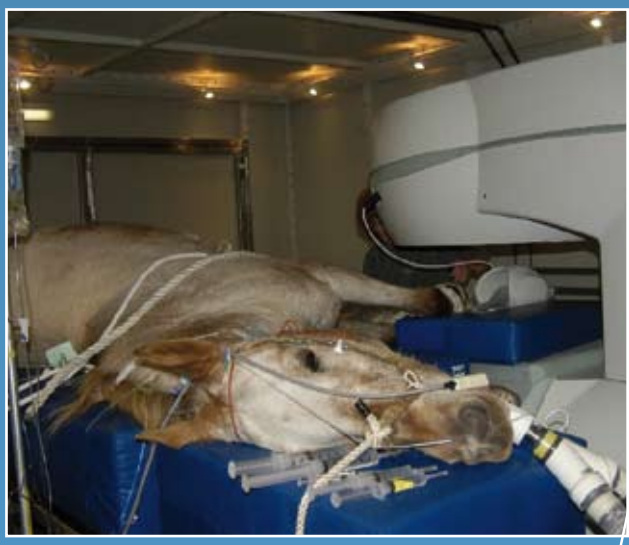
The main difference between these two methods is their timeliness and sensitivity. In other words, radiology provides very accurate information on the damage but at a late stage, and for this reason it is highligh specific but hardly sensitive; bone scanning, on the other hand, provides less accurate information but at an early stage, thus being highly sensitive yet hardly specific.

The quantity of technetium withheld by the bone is directly proportionate to the intensity of its metabolism: its increase is a sign that a remodeling and mineral change is underway. The conditions causing this type of bone remodeling include inflammations, connected with the most common orthopaedic diseases. Except for rare occasions, the damages caused to a bone by an inflammation trigger an incrase in the remodeling, which creates areas of high radioactivity in the scanning called hot spots.

Bone remodeling

The bone is not as inert as it looks, but it is in constant evolution. The entire skeleton is, to a varying degree, involved in this change which results in the accumulation of radiopharmaceuticals.

The intensity of the bone remodeling depends on the presence of inflammations but also by completely normal events. That is why it is not unusual to detect a certain increase in activity near the areas where the bones of young people or animals are growing or in the areas absorbing the highest load. Another



element to take into account is the blood flow: an increase or decrease (as in the case of an inflammation) can affect the accumulation of the radioisotope, causing it to rise or drop up to 2-3 times the normal values.

Exam timings and phases

From the moment in which the radiopharmaceutical is injected, its uptake in the body follows three different phases.

The early stage, called "vascular phase", begins immediately after the injection and only lasts a few minutes. During this phase the radiopharmaceutical spreads to all the blood and can provide information on the flow towards the various areas, thus identifying areas with a higher or lower level of circulation.

The second stage, called "soft tissue phase", begins 5-10 minutes after the injection. The radiopharmaceutical spreads gradually, concentrating in every tissue where the blood is flowing very actively, for example in inflamed tissues.

The third phase begins two or three hours after the injection and is called the "bone phase"; 60-70% of the radiopharmaceutical is now concentrated on the bones and the remaining quantity is almost entirely expelled through urine. During this phase there is no longer radioactivity in the blood. Most of the remaining radioactivity is concentrated in the bladder.

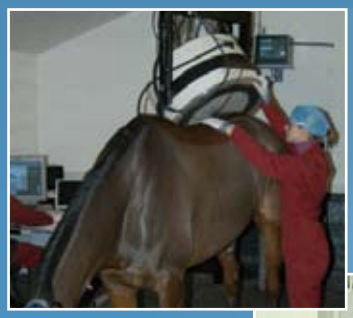
Sometimes, during the second and third phase radioactivity concentrates in the damaged muscle tissue, and this must be taken into account, given its relevance but, more than anything, to avoid interpretation errors.

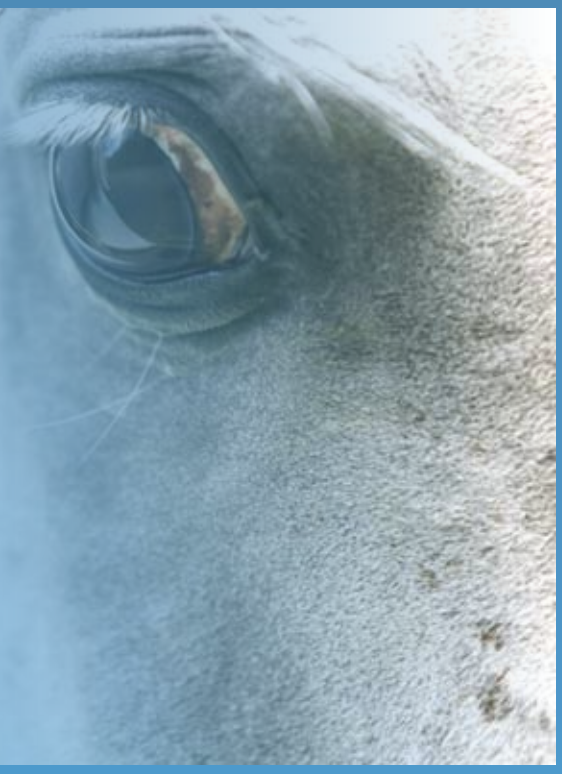
Diagnostic images can be taken during each of the phases described above. However, the most inportant information for bone scanning undoubtedly comes from the third phase.

Structures and equipment used for horses

In order to carry out a risk-free scintigraphy, it is necessary to use equipment and structures that make the exam as safe as possible.

All the manual procedures aimed at preparing the radiopharmaceutical take place in the "hot room", which can be accessed only by the authorized staff wearing protective anti-radiation garments. The room, with layers of lead within its walls, are covered by easily





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washable materials.
Radiation contamination is checked with a Geiger counter. If necessary, the person is decontaminated. The contaminating refuse (syringes and bottles with traces of the radiopharmaceuticals, contaminated garments, etc.) are disposed of in specific sealed containers where the contaminated material remains until the decay of the remaining radioactivity is completed.
A washable material covers the floor and the walls of the entire path followed by the horse before and after the scan.
The loose boxes accommodating the horses do not allow for the separation of urine, so a radiation warning sign is put up at the moment of the injection and kept there for the subsequent 48 hours. During this period, staff access to the box is kept to a minimum and the bedding is not changed until the technetium has completely decayed. When the warning sign is removed, the bedding can be treated in the same way as any other stud farm refuse.
The quantity of radiopharmaceutical injected in the horse is usually calculated according to the principle of the minimum quantity and therefore it varies according to the sensitivity of the gamma camera, the time available for the imaging and, obviously, the weight of the horse. After the exam, the horse is led back to the loose box where he/she will be kept for 48 before being discharged.

Bone scanning is becoming increasingly important as a diagnosis tool. However, bone scanning is only one aspect and should never replace an accurate clinical exam accompanied by diagnostic anesthetics and x-ray exams, which continue to be a fundamental tool in diagnosing lameness in sport horses. ❑