

radiology community, both users and suppliers alike, has to ask what value imaging brings to collaborative work and how this value is best realized [50].

Veterinary imaging has the privilege and challenges that go with continued development of current and new imaging technologies and modalities. Despite the range of imaging technologies, most of them are based on either sound or electromagnetic waves or a combination thereof. Optical imaging is an emerging modality that promises information on morphology, physiology, and tissue composition [51]. Training and retaining these individuals in veterinary imaging is not trivial; the challenge in doing so, and the consequences of failure are well recognized [52]. So, up to date and active specialists are needed. There is a limited basis due to a general lack of practicing knowledge of those imaging modalities and, particularly for CT, the relatively high cost of the tests.

Not every animal owner is willing or able to spend several hundred dollars on a sonogram or several thousand on a CT. Many general veterinary practitioners do not train in the field of sonography specifically. Rather than investing the time in learning and mastering sonography, they will either get by without it or contract to outside specialty imaging agencies or mobile practices. These practice raises the questions of which can, and who should, perform animal sonograms [53].

There are currently no veterinary sonography accreditation bodies or certifications (outside of possessing a doctor of veterinary medicine degree), and no dedicated programs are currently being offered. There are some short-term training courses available for a substantial fee which does offer hands-on training, but the majority of veterinary sonographers learn the science and application through on the job training, just as diagnostic medical sonographers did so many years ago. The field of veterinary sonography is just as operator dependent as in human medicine. Similarly, there are many different types of protocols currently being utilized. Unlike in human medicine, there are no established guidelines or standards of practice on what a specific examination must include for consideration for reimbursement [53].

Fluoroscopes are also generally confined to referral hospitals and academic institutions due to cost and the specialised level of diagnostic imaging knowledge needed in order to interpret the images generated accurately. Practices using fluoroscopy must adhere to the local rules as set out by their Radiation Protection Advisor (RPA) and work within the guidance given in the IRR99 documents. Patients undergoing examination with most of imaging techniques will usually require general anaesthesia or deep sedation in order to ensure complete immobilization [53].

3. Health and safety

Strict health and safety protocols must be adhered to when working with ionizing radiation. An external Radiation Protection Advisor (RPA) must be appointed to devise local rules, systems of work and written arrangements for working with X-rays in practice safely. Documents and protocols will be tailor-made for each practice and overseen on a daily basis by the Radiation Protection Supervisor(s) who work on the premises. The Ionising Radiations Regulations; Guidance Notes for the Safe Use of Ionising Radiations in Veterinary Practice should be available according to the countries used the imaging equipments which is important when working with X-rays in veterinary practice. Personal protective equipment, such as aprons, thyroid guards and gloves of a suitable thickness of lead-equivalent material (as directed in the local rules) must be available for use where necessary.

Personnel should take particular care when entering MRI scanning rooms, as the machines are effectively very large magnets. Ferromagnetic objects such as oxygen cylinders, scissors, stethoscopes, hair grips, coins, keys and mobile tables will be drawn towards the magnet when they get too close, and this could result in serious injury or even death of personnel if hit or trapped by these objects. It is vital that all workers and visitors are aware of this risk and take steps to avoid them. MRI scanners can be differentiated by their magnetic strength into low-field and high-field scanners, the latter posing a higher potential health and safety risk due to the higher field strength. The functionality of medical devices such as pacemakers may be disrupted by the strong electromagnetic fields of an MRI scanner. For this reason, staff must read and sign a health and safety questionnaire prior to working with MRI, to ensure they are deemed safe to do so. Further contraindications to working in MRI are ferromagnetic implants (for example,

orthopaedic plates) and foreign bodies, which have the potential to heat up and/or migrate through tissues (54).

Unlike conventional X-ray machines, instead of a single tube head mounted above the patient, the high-powered tube located inside a CT machine rotates around the patient's anatomy, slice by slice. As the X-ray beam is attenuated by the patient (weakened, depending upon the density of the tissue through which it travels), a panel of detectors on the opposing side receive the remaining radiation, producing an electrical signal. Labruyère and Schwarz [32] describe how the signal generated is directly proportional to the density of the tissue it has penetrated.

4. Conclusion

There are several options available to the veterinary clinician to perform diagnostic imaging studies. The choice will depend on a number of factors, including cost, availability, expertise of staff to carry out the examination and interpret the images afterwards and the disease process under investigation. Often there is no right or wrong imaging modality for a case, and using more than one method to build a complete picture of the condition may be of great benefit. The various challenges facing the veterinary imaging community are more exciting than problematic. The problems like high cost of the equipments, few trained professionals and safety issues can be assemble and coordinate as many skilled minds, from as many spheres of activity as possible, to focus on advancing the field.

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