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Diagnostic imaging is critical not only for the diagnosis of cancer but also for staging patients and for following the response to therapy. Staging is an important part of the work-up of canine cancer patients and is performed to identify the tumor type, its location, extension (severity) and prognosis. Diagnostic imaging modalities evaluate the primary tumor, the regional lymph nodes and metastasis in distant organs. These modalities also contribute to the therapeutic and diagnostic planning through the selection of the best approach for that particular patient. Concerning to imaging modalities the word “best” does not necessarily mean image quality and resolution, high sensitivity and state-of-the-art technology. “Best” means doing a good job using an available and affordable imaging modality in the diagnostic approach.

The most frequently used imaging modalities for the diagnosis of cancer are conventional radiographs and ultrasonography (USG), but computed tomography (CT), magnetic resonance imaging (MRI) and nuclear medicine (Nucmed) are increasing in availability and usage. USG, CT, MRI and Nucmed have not replaced conventional radiographs but serve to complement them. Radiography: is the mainstay of veterinary imaging because it is widely available, inexpensive and is a good screening exam that helps the selection of further diagnostic procedures. It is used mainly for the detection of lung metastasis, sternal lymph node enlargement, thoracic masses in dyspneic patients and assessment of bone tumors. Also, it complements the ultrasonographic exam in patients with large abdominal masses by providing a better and wider topographic view of the abdominal cavity. A simple lateral view of patients with non-fluid abdominal distension is an excellent topographic guide to the ultrasonographic exam. Like a road map it may alert the examiner to atypical gas distribution, gastric overdistension by ingesta or gas, fecal accumulation, urinary bladder over or under distension, intra-parenchymal or free-gas and other findings.

Ultrasonography: ultrasonography has become a widely available diagnostic modality in veterinary medicine and is an invaluable tool in the diagnostic approach of cancer patients. USG enables the evaluation of parenchimal organs echogenicity, architecture, size, margins and extension on involvement. Ultrasonography can evaluate abdominal organs, visceral lymph nodes, superficial lymph nodes, superficial tumors, thoracic masses and can be used as guide for fine needle aspirations and biopsies procedures. Ultrasound guided procedures are often the most practical when viewed from the aspects of patient morbidity, client finances and clinical ease. Doppler technology permits the study of amount, distribution, architecture and flow indices of blood vessels that helps to determine the propensity towards malignancy. Intralodal (lymph nodes) vessels may also be evaluated. Other innovations include intraoperative sonography, harmonic imaging and microbubble contrast media. Contrast ultrasound improves the detection and characterization of liver, spleen and kidney nodular lesions. The most common contrast used is Definity®.

Nuclear medicine (scintigraphy): used for the assessment of skeletal metastasis and functional thyroid masses. Lymphoscintigraphy may be the next step in veterinary oncology.

Computed tomography (CT): It’s the production of tomographic images (slices) using x-rays and computers. CT compared to conventional radiographs has excellent contrast discrimination and the ability to separate deep structures without the superimposition of overlying tissues. Tissue changes on CT can be seen earlier and more accurately. Most imaging protocols call for the same image set to be acquired before and after intravenous administration of a nonionic contrast agent. The contrast agent accumulates in highly vascular tissue or in tissues with increased vascular permeability. Contrast-enhanced CT is useful for assessment of tumor vascularity and regional blood flow. CT can also be used to assist in biopsy or fine needle aspiration of suspected neoplastic
lesions. Clinical applications are: brain, spinal and paraspinal tumors, nasal tumors, tumors of the skull and oral cavity, intrathoracic neoplasia, metastatic lung disease, mediastinal tumors, staging of intra-abdominal neoplasia and extremities neoplasia 4.

Magnetic resonance imaging (MRI): on MRI the contrast between different soft tissues is superior to all other imaging modalities making it an excellent modality to evaluate tumors arising within soft tissue structures. General anesthesia is required and monitoring of patients can be difficult. Nothing is superior for imaging the central nervous system 1. The principles of imaging formation with MRI are not based on the attenuation of an x-ray beam as in CT but are based on the chemical and physical states of the tissue. Clinical applications: MRI is the preferred modality for detection, staging and management of malignancy within the central nervous system – neuroimaging, head and neck tumors and tumors of the extremities. The major limitation of MRI is still the initial cost of the equipment and the annual maintenance cost. Currently the choice between CT and MRI in veterinary medicine is largely based on economics and availability 4.

Positron emission tomography (PET): PET is a functional imaging modality that is useful in characterizing physiologic process, such as blood flow or glucose metabolism; visualizing ongoing biochemical and metabolic activities of normal and abnormal tissues. In oncology, the main focus is on detection and staging of malignancy. PET/CT is a fusion of PET and CT images to improve anatomic detail. Lack of available equipment and high cost of PET radiopharmaceutic agents have limited the use of PET in veterinary oncology 4.

**Contribution and goals of diagnostic imaging modalities:**

A localized view of the goal of diagnostic imaging would be that it should provide the best images and the most accurate diagnosis possible. Certainly this should be a prime concern of radiologists. But a more global analysis reveals diagnostic imaging to be part of a larger system whose goal is to treat patients effectively and efficiently. In this larger context, even high-quality diagnostic imaging may be noncontributory in certain instances, and radiology of lesser quality may be of great value in others. Refer to Fryback & Thornbury (1991) hierarchical model of efficacy in diagnostic imaging.

When considering a diagnostic test (in this case, imaging modalities) the clinical impact (contribution or efficacy) can be divided in categories (similar to Fryback & Thornbury model): **diagnostic impact, therapeutic impact and prognostic impact**. Each imaging modality may contribute in different levels for each category). For instance, a thoracic x-ray for metastasis check has a minor diagnostic impact but an important prognostic impact. On the other hand, hypechoic splenic nodules seen on USG have important diagnostic impact (indicating the need for FNA) and minor prognostic impact.

Diagnostic impact encompasses lesion(s) detection and characterization, affected organs, presumed malignancy, differential diagnosis list, biopsy or FNA recommendation, biopsy site selection and guidance, etc.

Therapeutic impact involves the use of imaging findings to guide therapy: clinical or surgical approach, less or more aggressive (staging) chemotherapy, immediate surgery (HSA rupture, for example), surgical resection planning, thoracocentesis for pleural effusion, etc.

Prognostic impact involves the evaluation of neoplastic extension and severity: thoracic and abdominal effusions, carcinomatosis, regional or distant lymphadenopathy, mass ruptures, pulmonary metastasis, bone metastasis, obstructive hydronephrosis, etc.

For cancer patients, when choosing an imaging modality for a particular patient and clinical situation we should have in mind what specific question is to be answered by that exam. There is no “good for all” exam. Also, the goal is not to obtain the best, high-quality, top resolution image. The goal is to help the patient. It is a common mistake to believe that the newest technology will provide all the needed information and the best approach for the patient. There is no such machine. I recommend the use of the oldest diagnostic tools: our brain, knowledge and judgment to choose the most accurate, available and affordable imaging exam(s) for each of our patients.
References:
4- LeBLANC, AK; DANIEL, GB Vet Clin N America 2007:37,1059