Computed Tomography Imaging in Oncology

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KEYWORDS

• CT • Dog • Cat • Oncology • Radiotherapy • IMRT • IGRT

KEY POINTS

- The availability of CT technology in veterinary medicine has increased its use as a first-line imaging modality to evaluate the thorax for primary and metastatic pulmonary tumors, and mediastinal and thoracic wall tumors.
- Often, simultaneous abdominal CT imaging screens for other tumors or metastasis.
- A presurgical CT evaluation helps to inform surgeons about the extent, and whether complete tumor resection is possible.
- Triple-phase vascular CT imaging can identify vascular invasion of tumors.
- CT imaging plays a crucial role in radiotherapy treatment planning, and many linear accelerators have on-board CT imaging for daily image guidance to ensure accurate treatment delivery.

COMPUTED TOMOGRAPHY FOR CANCER STAGING: THORAX

Thoracic imaging is the first step in cancer staging for dogs and cats with known or suspected tumors. Following our colleagues in human oncology along with validation from veterinary literature, thoracic computed tomography (CT) plays an important role in screening for pulmonary and thoracic primary and secondary malignancies.[1–11]

Equipment and Technique

Helical CT scanners allow rapid image acquisition and provide superior delineation of thoracic masses, metastases, and involved thoracic lymph nodes. Dogs and cats are usually under general anesthesia, placed in sternal recumbency, and imaged precontrast and postcontrast administration. At our institution dogs and cats are induced in CT and immediately positioned in sternal recumbency. Using a plexiglass cylinder for cats and small dogs with light or no sedation has also been reported.[12,13]

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At our institution the thorax protocol on a GE helical CT scanner (GE Healthcare, Hartland, WI) is 120 kVp, 150 to 250 mA, with 1.25 mm contiguous slices for most patients and 2.5 mm for large dogs. The window/level for mediastinum and precontrast evaluation is W = 400/L = 40 and for lung is W = 1500/L = − 700 (**Table 1**). Patients are manually hyperventilated just before slice acquisition to reduce expired CO_2. This decreases respiratory motion on images. Dorsal and sagittal plane reconstructions are obtained in lung window and mediastinal window postcontrast administration.[4] Other protocols also exist in the literature.[9,14–17]

Pulmonary and Thoracic Masses

Sensitivity of CT for metastasis detection is far superior to radiographs.[1,2,5,6,8,9] Identification and delineation of primary lung, mediastinal, heart base, and pleural tumors is also superior with CT imaging.[1,3,4,7,10] However, as in human patients, no specific CT roentgen signs have been associated with neoplastic conditions in dogs and cats.[18,19] Possible exceptions to this include bronchioalveolar carcinoma in the cat[20,21] and histiocytic sarcoma in the dog.[22,23] Feline and human pulmonary bronchioalveolar carcinoma can present with cavitated pulmonary masses, bronchiectasis, and bronchial wall thickening (**Fig. 1**).[20,21,24] Canine pulmonary histiocytic sarcoma has been reported to present as a large mass with thoracic lymphadenopathy and an internal bronchus with a predilection for right middle or left cranial lung lobes.[22,23] Primary lung tumors generally metastasize to tracheobronchial lymph nodes (**Fig. 2**),[3,4,7] but dogs with histiocytic sarcoma also show involvement of craniomediastinal and sternal lymph nodes.[23]

Common mediastinal tumors in dogs and cats include thymoma, heart base tumors, and lymphoma.[25] Additional tumor types also include carcinoma, ectopic thyroid carcinoma, and mesothelioma.[26] CT evaluation of these tumors is generally nonspecific; however, thymoma tumors often have heterogeneous contrast uptake, and CT evaluation inconsistently detects vessel invasion (**Fig. 3**).[27,28]

COMPUTED TOMOGRAPHY FOR SURGICAL PLANNING: THORAX

Similar techniques are used for surgical CT planning. Smaller slice thickness through a particular area may be requested by the radiologist to better delineate margins and invasiveness.[28] Use of CT angiograms and three-dimensional reconstruction software improves diagnostic quality.

Table 1
CT techniques

Technique	Slice Thickness	Window/Level
Thorax CT		
120 kVp/150–250 mA	1.25–2.5 mm	Mediastinum: W = 400/L = 40 Lung: W = 1500/L = −700
Skull CT		
120 kVp/100–150 mA	0.625–1.25 mm	Soft tissue: W = 400/L = 40 Bone: W = 2000/L = 300
Neck CT		
120 kVp/100–150 mA	1.25–2.5 mm	Soft tissue: W = 400/L = 40
Abdomen CT		
120 kVp/150–300 mA	1.25–2.5 mm	Soft tissue: W = 400/L = 40