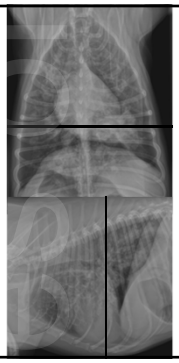
Principles and clinical applications of Veterinary Computed Tomography

Hock Gan Heng,
DVM, MVS, MS,
Diplomate ACVR, ECVDI,
Purdue University,
hheng@purdue.edu

Introduction

- Uses X-ray but produce axial sectional or slice orientation imaging
- Advantage:
  - Detect abnormalities in areas where there is lot of superimposition on plain radiography
  - Nasal turbinates, brain (skull), spinal cord (vertebrae)
  - Able to optimize visualization of different structures with different windows and levels



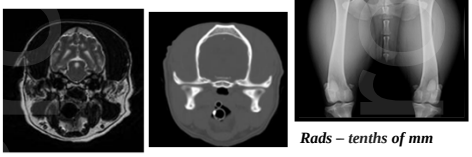
Example of CT and radiography

CT-benefits and drawbacks

- Benefits
  - Very good for bony lesions
    - Tumors
    - Fractures
    - Degenerative disease
  - Thoracic, abdominal and soft tissue masses
  - Some vascular issues
  - Fast < 5 minutes (scan only)
- Drawbacks
  - Less soft tissue contrast than MRI
  - Expensive equipment
    - $100,000-1,300,000
  - Requires general anesthesia or sedation

Whole body scan

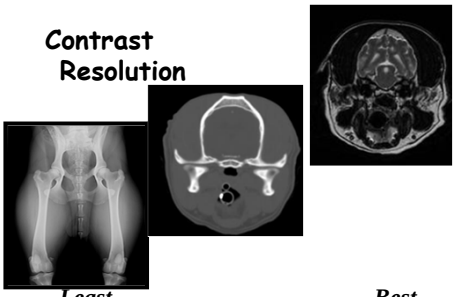
Spatial Resolution



Rads – tenths of mm

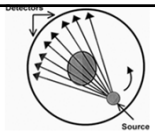
MRI & CT resolution depends on scanner design, acquisition and display matrix (mm range)

Contrast Resolution

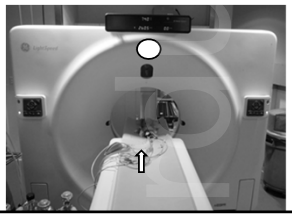


Least ***Best***

CT Basics



- **Gantry** :
  - X-ray tube
  - Electronic detector mounted 180º opposite the tube- converts x-ray energy into electrical current
  - Collimator
- Table : Patient lays on table and is moved through gantry as tube goes around



6th generation CT scanner

- Slip-ring technology
- Helical CT
- Facilitate continuous X-ray tube rotation
- Able to image a given volume faster: especially beneficial for CT angiography

OVERHEATING

7th generation CT scanner

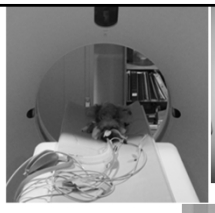
- More effectively use of available X-ray beam
- Wider width of X-ray
- Multiple rows of detectors
- Data can be collected for more than one slice at a time and reduce total number of rotations

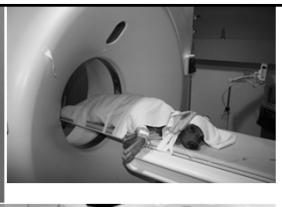
7th generation CT scanner

- Multiple rows of detectors
- Wider width of X-ray
- 2,4, 8, 16, 32, 64, 128, 256-slice scanner
- Advantages:
- Thin slices
  - 3-D recontruction
  - Elimination of partial-volume artifact

Patient set up

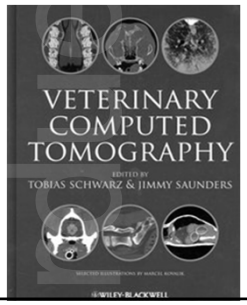
- STILL: no movement : reducing motion un-sharpness
  - General anesthesia
  - Deep sedation
- Fast scan: awake for very sick patients
- Symmetry: compare of the right and left

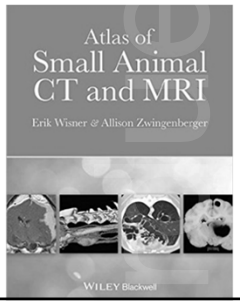




Vetmousetrap™

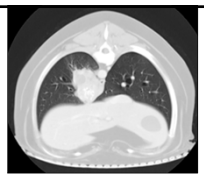
Textbook…..

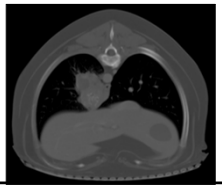


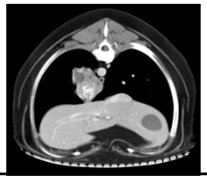


Displaying CT study

- Lung window
- Bone window
- Soft tissue window





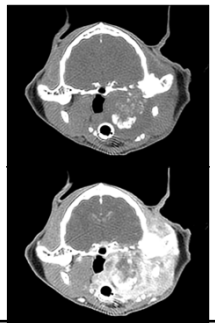


Terminology

- Attenuation: Soft tissue attenuating structure, fat attenuating structure
- Hyperattenuating, hypoattenuating
- Heterogeneous, homogeneous

CT contrast study

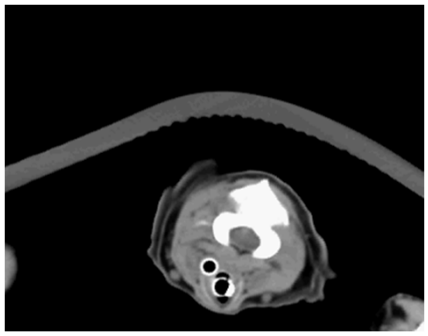
- Investigation of the vascularity of neoplasia
- Investigation of the invasiveness of neoplasia
- Vascular study: PSS
- Urinary system



General Application

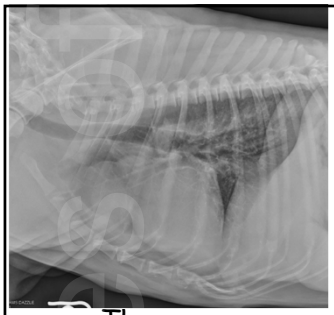
MASS

- Extent of disease
- Organ of origin
- Margins
- Blood supply
- Surgical or non-surgical



Applications

- Thorax:
  - Lungs – gold standard for metastatic evaluation
- Bones – Nasal cavity, elbows, pelvis
- Abdomen
  - Neoplasia margins
  - Shunt hunt: portosystemic shunt



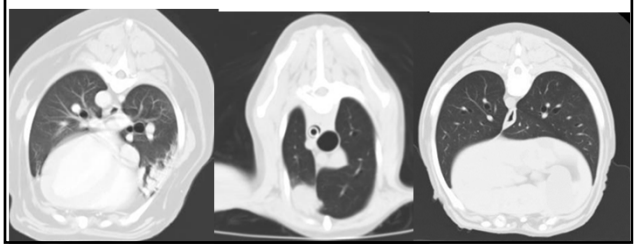
Thorax

Lungs and bronchi

- Metastatic check of a known tumor
- To rule in or rule out of lung mass
- Determine the cause of Spontaneous pneumothorax - bulla or bleb
- Characterizing lung mass and search for additional nodule(s)
- Characterizing bronchiectasis
- Determine the resectability of a lung mass

Lungs and bronchi

abnormal features



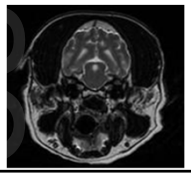
Lungs and bronchi abnormal features

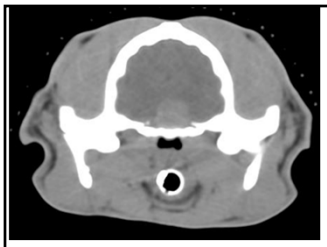
Head

- Brain
- Skull
- Nasal cavity
- Tympanic bullae
- Metastatic neoplasia (lymph nodes)

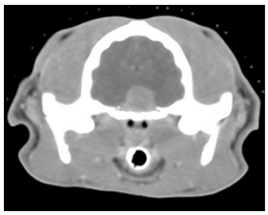
Brain

- Normal brain parenchyma
- Ventricular system: hypoattenuating

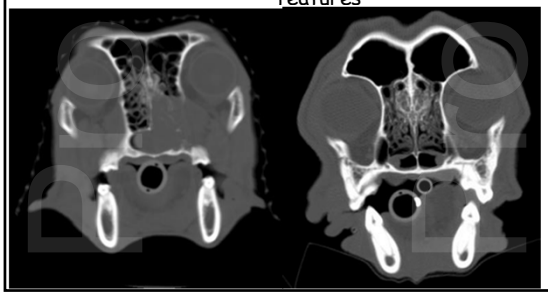




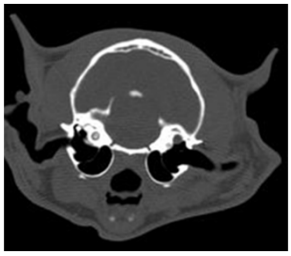
Brain

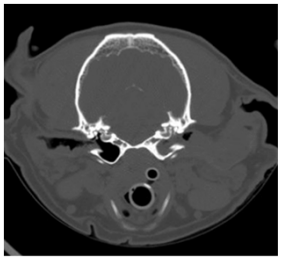


Nasal cavities and frontal sinuses Abnormal features



External, middle and inner ear



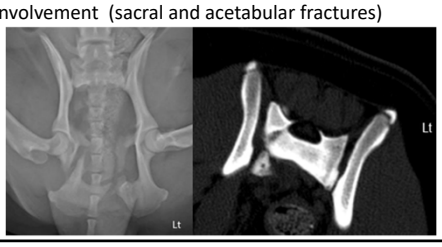


Bones

- Fracture: Skull, pelvic, joint involvement
- Elbow
  - Fragmented medial coronoid process
  - Osteochondritis dissecans
  - Joint incongruity

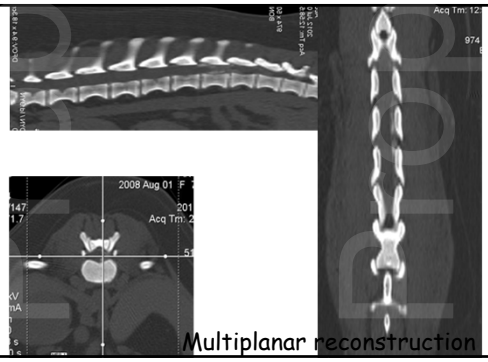
Pelvic fracture

- Radiography underestimate of pelvic fracture : the joint involvement (sacral and acetabular fractures)



Vertebral column

- Faster, cheaper than MRI
- Intervertebral disc disease: degree of compression and the exact location of compression
- Sometimes difficult to diagnose
- CT myelography
- Fracture vertebrae and spinal cord compression
- Vertebral neoplasia
- Early discospondylisis

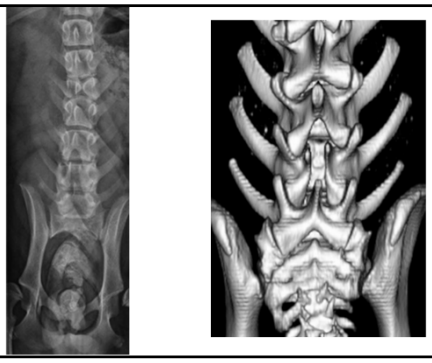


CT angiography

- Vascular anomaly
- Dynamic contrast study
  - Record temporal changes in the density characteristic by an object
  - Three-phase CT angiography: PSS

The Veterinary clinics of North America Small animal practice 2009;39(4): 783-792

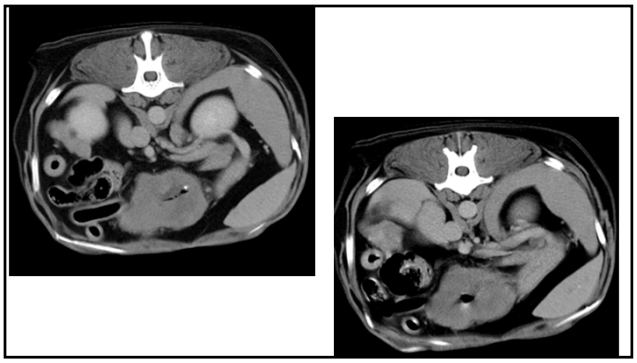
CTA for PSS



What is new?

- CT of the gastrointestinal tract!
- CT was more sensitive (95.8% vs. 79.2%) and specific (80.6% vs. 69.4%)n for detecting mechanical intestinal obstruction.

COMPARISON OF COMPUTED TOMOGRAPHY AND ABDOMINAL RADIOGRAPHY FOR DETECTION OF CANINE MECHANICAL INTESTINAL OBSTRUCTION. ***Vet Radiol Ultraound*** 2016 Jul;57(4):366-75.



Take home message

Complimentary to other diagnostic imaging modalities

Will help to characterize the lesion

Fast diagnosis for certain diseases

Thank you