Program Overview

2004 ACVR SCIENTIFIC CONFERENCE
August 2-6 2004

Monday August 2\textsuperscript{nd}

7:00 am Registration

8:00 am Concurrent didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging

10:00 am Break with exhibitors

10:30 am Concurrent didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging

12:30 pm Lunch

1:30 pm Concurrent didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging

3:30 pm Break with exhibitors

4:00 pm Concurrent didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging

5:00 pm Ultrasound program concludes. MRI case forum.

6:00 pm Conclusion
Tuesday August 3rd

7:15 am  *CT/MRI Society Meeting*
8:00 am  CT/MRI Scientific Session
10:00 am Break with exhibitors
10:30 am CT/MRI Scientific Session continues
11:30 am Nuclear Medicine Scientific Session
12:30 pm Lunch
1:30 pm Diagnostic Ultrasound Scientific Session
3:30 pm Break with exhibitors
4:00 pm Informal forum on Digital Imaging, Radiology Information Systems and Picture Archiving and Communication Systems

Wednesday August 4th

7:15 am  *Nuclear Medicine Society Meeting*
8:00 am Official Welcome
8.05 am ACVR Presidential Address – Dr. Gregory Daniel
8.30 am ACVR Keynote Address
‘Interventional Radiology’
Dr Marie-France Giroux, MD
10:00 am Break with exhibitors
10:30 am General Diagnostic Radiology Scientific Session
12:30 pm Lunch
1:30 pm ACVR Business Meeting
3:30 pm Break with exhibitors
4:00 pm Annual ACVR Image Interpretation Session
Thursday 5th August

7:15 am    Diagnostic Ultrasound Society Meeting

8:00 am    Radiation Oncology Keynote Speaker
           ‘Electron Beam Therapy’
           Dr. Bhudatt Paliwal, PhD.

10:00 am   Break with exhibitors

10:30 am   Radiation Oncology Scientific Session

11:30 am   Radiation Oncology Forum

12:30 pm   Lunch

1:30 pm    Radiation Oncology Forum continues

2:30 pm    VRTOG and RO Business Meetings
2004 ACVR SCIENTIFIC CONFERENCE
August 2\textsuperscript{nd} - 6\textsuperscript{th} 2004

Monday August 2\textsuperscript{nd}  CONCURRENT SESSION 1

Didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging will be run concurrently all day.

Diagnostic Ultrasound Program

Sponsored by the Veterinary Ultrasound Society (VUS) of the ACVR and the International Veterinary Ultrasound Society (IVUSS).

8:00 Doppler Ultrasound: Artifacts and Interpretation in Clinical Practice
   Dr. Peter Burns, PhD, MD

9:00 What’s New in Ultrasound Imaging: Bubbles, 3D, and more…
   Dr. Peter Burns, PhD, MD

10:00 BREAK WITH EXHIBITORS

10:30 Echocardiography of challenging cases
   June Boon

11:30 What’s new and what's coming in Echocardiography
   June Boon

12:30 LUNCH

1:30 Advanced Musculoskeletal Ultrasound
   Dr. Craig Long, DVM

2:30 Advances in Ocular Ultrasound
   Dr. Kathy Spaulding, DVM

3:30 BREAK WITH EXHIBITORS

4:00 Gastrointestinal Ultrasound Part 1
   Dr. Dominique Penninck, DVM

5:00 Gastrointestinal Ultrasound Part 2
   Dr. Dominique Penninck, DVM
CONCURRENT SESSION 2

Didactic sessions in Diagnostic Ultrasound and Magnetic Resonance Imaging will be run concurrently all day.

**Magnetic Resonance Imaging**

Sponsored by the CT/MRI Society of the ACVR.

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<th>Time</th>
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<td>Animal Specific MRI: Technical Considerations and Pulse Sequence Applications</td>
<td>Dr. J Helpern, PhD and Dr. Craig Branch</td>
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<td>9:00</td>
<td>Aspects of spinal MRI in humans</td>
<td>Dr. Charles Ho, PhD, MD</td>
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<td>10:00</td>
<td><strong>BREAK WITH EXHIBITORS</strong></td>
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<td>10:30</td>
<td>MRI of the spine – an animal perspective</td>
<td>Dr. Amy Tidwell, DVM</td>
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<td>11:30</td>
<td>Aspects of orthopedic MRI in humans</td>
<td>Dr. Charles Ho, PhD, MD</td>
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<td><strong>LUNCH</strong></td>
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<td>1:30</td>
<td>Orthopedic MRI – an animal perspective</td>
<td>Dr. Pat Gavin, PhD</td>
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<td>2:30</td>
<td>Principles of Brain MRI in animals, Part 1</td>
<td>Dr Rodney Bagley, DVM</td>
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<td>4:00</td>
<td>Principles of Brain MRI in animals, Part 2</td>
<td>Dr Rodney Bagley, DVM</td>
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<td>5:00</td>
<td>MRI case review forum</td>
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Tuesday August 3rd 2004

7.15  CT/MRI Society Meeting

Scientific Session: CT/MRI

8:00  Use of multislice helical CT to determine an attenuation value (HU) of adrenal gland in healthy dogs and dogs affected by hyperadrenocorticism
Dr. Giovanni Bertolini, Veterinary Clinic “San Marco”, Italy

8:12  Comparison Of Computed Tomography Using Iohexol And 99m Tc-DTPA Scintigraphy For Determination Of Relative Canine Glomerular Filtration Rate
Dr. Alan Lipman, North Carolina State University

8:24  High resolution Computed Tomography of the normal canine lung
Dr. Victoria Johnson, University of Pennsylvania

8:36  MRI features of feline fibrosarcomas
Dr. Francisco Llabrés-Díaz, Animal Health Trust, England

8:48  Quantitative ultrasound analysis and magnetic resonance image analysis of iron accumulation in the liver of birds
Dr. Jodi Matheson, University of Wisconsin

9:00  The evolution of a whole-body MRI protocol
Dr. Elissa Randall, Colorado State University

9:12  A comparison of radiology versus computed tomography in the diagnosis of middle ear disease in the dog
Dr. Jacob Rohleder, Virginia-Maryland Regional College of Veterinary Medicine

9:24  Magnetic resonance imaging of canine cranial nerve anatomy and pathology
Dr. Ryan Schultz, Washington State University

9:36  Computed Tomography for identification of early third metacarpal traumatic palmar subchondral bone lesions
Dr. Helen Thomas, University of California, Davis

9:48  Spiral CT angiography of pulmonary artery tree in dogs: development and use of test bolus injection protocol
Dr. Amy Tidwell, Tufts University School of Veterinary Medicine

10:00  BREAK WITH EXHIBITORS
10:42 Comparison of clinical findings and computed tomography characteristics in feline sinonasal disease: a retrospective study
Dr. Tonya Tromblee, Virginia-Maryland Regional College of Veterinary Medicine

10:54 Magnetic resonance imaging accurately determines synovial fluid volume in canine stifle joints
Dr. William Widmer, Purdue University School of Veterinary Medicine

11:06 Computed Tomographic analysis of canine and feline urinary calculi: an in vitro study
Dr. Christine Yee, University of Georgia

11:18 Computed Tomography-guided sampling of intra-thoracic lesions in thirty dogs and cats
Dr. Lisa J. Zekas, University of Wisconsin-Madison

Scientific Session: Nuclear Medicine

11:30 Ultrasound guided transplenic portal scintigraphy with $^{99m}$TcO$_4^-$ and its comparison to per-rectal portal scintigraphy
Dr. Robert Cole, University of Tennessee

11:42 Use of ultrasound guided transplenic portal scintigraphy with $^{99m}$TcO$_5^-$ to diagnose portosystemic shunts in dogs
Dr. Robert Cole, University of Tennessee

11:54 Determination of release criteria for I-131 therapy cats
Dr. Kristina Miles, Iowa State University

12:06 Effects of Methimazole on thyroid gland uptake of $^{99m}$Tc-pertechnetate in hyperthyroid cats
Dr. Anthony Fischetti, The Ohio State University

12:18 Accuracy of elevated thyroid: salivary ratio during subcutaneous thyroid scintigraphy for diagnosing feline hyperthyroidism
Dr. Richard Page, Cornell University

12:30 LUNCH

Scientific Session: Diagnostic Ultrasound

1:30 Comparison of the cellularity of ultrasound guided biopsy samples using spinal and standard needles
Dr. John Feleciano, VDIC, Oregon

1:42 Echocardiographic indices in normal Belgian Malinois and German Shepherd Military working dogs
Dr. David Fletcher, Colorado State University
1:54  **Echoendoscopic versus transabdominal ultrasound of the canine stomach: A case series**  
Dr. Lorrie Gaschen, University of Bern

2:06  **Pancreatic duct dilation in cats – a prospective and retrospective study**  
Dr. Silke Hecht, Tufts University School of Veterinary Medicine

2:18  **Cross-sectional anatomy and comparative ultrasonography of the equine stifle joint**  
Dr. Jimmy Saunders, Ghent University

2:30  **Doppler ultrasonographic evaluation of gastrointestinal blood flow in dogs with IBD and food hypersensitivities**  
Dr. Patrick Kircher, University of Berne

2:42  **An evaluation of the intra- and inter-observer variability of the ultrasound measurement of the thyroid gland in beagle dogs**  
Dr. Jimmy Saunders, Ghent University

2:54  **Effect of phenstatin phosphate on tumor perfusion: evaluation in a rat model using microbubble contrast agent**  
Dr. Jodi Matheson, University of Wisconsin

3:06  **Ultrasoundographic evaluation of the canine external ear canal, tympanic membrane, and tympanic bulla after saline infusion into ear canal or tympanic bulla**  
Dr. Junghee Yoon, Seoul National University

3:18  **Transcutaneous ultrasonography of the abdomen in the normal common Marmoset (Callithrix jacchus)**  
Dr. Wencke Wagner, University of Pretoria

3:30  **BREAK WITH EXHIBITORS**

4:00  Informal forum on Digital Imaging, Radiology Information Systems and Picture Archive and Communication Systems
Wednesday August 4th

7:15 Nuclear Medicine Society Meeting

8:00 Official Welcome

8:05 ACVR Presidential Address – Dr. Gregory Daniel

8:30 ACVR Keynote Address
‘Interventional Radiology’
Dr Marie-France Giroux MD

10:00 BREAK WITH EXHIBITORS

Scientific Session: General Diagnostic Radiology

10:30 Evaluation of a scanner and digital cameras compared to direct viewing of radiographs for detection of pulmonary nodules
Dr. Laura Armbrust, Kansas State University

10:42 Serving images to the teaching hospital: a pilot study using tablet PCs
Dr David Barbee, Washington State University

10:54 Radiographic diagnosis of lung lobe torsion
Dr. Marc-André d’Anjou, Université de Montréal

11:06 Removing scatter without a scatter removing grid
Dr William Hornof, University of California, Davis

11:18 Subjective and objective radiographic assessments of sand accumulation in the equine gastrointestinal tract
Dr. Nathan Keppie, Michigan State University

11:30 Radiographic interpretation of the equine central and third tarsal bones for developmental orthopedic disease
Dr. Timothy O’Brien, University of California, Davis

11:42 Limited image quality comparison of film screen, direct digital radiography and computed radiography
Dr. Sarah Puchalski, University of California, Davis

11:54 Radiographic anatomy of the thorax and abdomen in the normal common Marmoset (Callithrix jaccus)
Dr. Wencke Wagner, University of Pretoria
12:06  **Accuracy of myelography at localizing thoracolumbar intervertebral disc prolapse, using post-myelographic computed tomography as the gold standard**  
Dr. Paul Rist, University of Florida

12:18  **Effects of breathing and cardiac motion on the spatial resolution in microscopic imaging techniques of rodents**  
Dr. Wilfried Mai, Duke University Medical Center

12:30  **LUNCH**

1:30  **ACVR Business Meeting**

3:30  **BREAK WITH EXHIBITORS**

4:00  **Annual ACVR Image Interpretation Session**  
Presenter: Dr Brian Poteet
Thursday 5th August

7:15 *Diagnostic Ultrasound Society Meeting*

8:00 **Radiation Oncology Keynote Speaker**
   ‘Electron Beam Therapy’
   Dr. Bhudatt Paliwal, PhD.

10:00 **BREAK WITH EXHIBITORS**

**Scientific Session: Radiation Oncology**

10:30 *Biodistribution of radiolabeled morpholino oligomers and antibodies in 5 normal dogs - feasibility study of tumor pretargeted immunoscintigraphy*
   Dr. Mauricio Solano, Tufts University Veterinary School

10:42 *Diagnostic imaging of OSA in dogs using radiography, $^{99mTc}$ – HDP and $^{111}$In labeled vitamin B12 scintigraphy: a comparative study*
   Dr Robert Cruz-Arámbulo, Oklahoma State University

10:54 *Assessment of vascularity and perfusion in spontaneous canine tumors with contrast-enhanced doppler ultrasound before and during fractionated radiation therapy*
   Dr. Stefanie Ohlerth, University of Zürich

11:06 *Epidermal growth factor receptor expression in canine oral cavity squamous cell carcinoma*
   Dr. David Proulx, North Carolina State University

11:18 *Prevalence of anemia in feline patients undergoing curative intent radiation therapy.*
   Dr. Philip Treuil, Colorado State University

11:30 *Alternative bolus materials for Cobalt-60 teletherapy radiation treatments – an evaluation of play-doh® and of water-soaked cotton gauze sponges*
   Dr. Michael Walker, Texas A&M University

11:42 *Assessment of perfusion and hypoxia in spontaneous canine tumors using positron emission tomography*
   Dr. Barbara Kaser-Hotz, University of Zürich

11:54 *Radiosensitivity of Canine Melanoma Cell Lines*
   Dr. Michael Kent, University of California, Davis

12:06 **Radiation Oncology Forum**

12:30 **LUNCH**
1:30  **Radiation Oncology Forum** continues

2:30 pm  VRTOG and RO Business Meetings
A STANDARDIZED PROTOCOL FOR THE ULTRASOUND EXAMINATION OF THE EQUINE STIFLE
M. Hoegaerts. D.V.M., J.H. Saunders. D.V.M. Department of Medical Imaging, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium

UNUNITED MEDIAL EPICONDYLE: DIAGNOSTIC ACCURACY AND PREVALENCE IN A COHORT OF LABRADOR RETRIEVERS
ER Paster, DVM; DN Biery, DVM DACVR; DF Lawler, DVM; RD Kealy PhD; PJ McKelvie, VMD; GK Smith, VMD PhD.Department of Clinical Studies, University of Pennsylvania School of Veterinary Medicine, Philadelphia, PA 19104

VALIDATION OF A 40 MHZ B-SCAN ULTRASOUND BACKSCATTER MICROSCOPE FOR THE EVALUATION OF OSTEOARTHRITIS LESIONS IN AN ANIMAL MODEL
M. Spriet D.V.M., C. Girard DVM, S. Foster Ph.D., D.W. Holdsworth Ph.D., S. Laverty MVB. University of Montréal, Saint-Hyacinthe, Canada, University of Toronto, Toronto, Canada University of Western Ontario, London, Canada.

SEGMENTATION OF M-MODE ULTRASOUND HEART IMAGES USING ACTIVE CONTOURS (SNAKES):
Introduction: Appropriate work-up of dogs with suspected Cushing’s Syndrome includes adren al and pituitary imaging. In human medicine, on basis of adrenal glands attenuation values at unenhanced and enhanced examinations, CT are helpful in differentiating normal from abnormal adrenal glands. Non enhanced CT and dynamic contrast-enhanced CT are usually performed to further differentiate benign from malignant lesions, with high sensitivity and specificity. In a recent meta-analysis of ten studies was determined that a threshold of 10 HU is associated to a 71% sensitivity and 98% specificity for characterizing adrenal masses and 100% specificity, when additional features such as size, shape, margins were considered. In veterinary medicine, ultrasonography is the most useful imaging modality for evaluating the adrenal glands in dog; CT and MRI are usually reserved to pituitary gland examination. The purpose of our study was to assess attenuation values of canine adrenal glands in non-enhanced and enhanced CT, performed on healthy and diseased dogs, as preliminary use a multislice helical computed tomography (MSHCT) in work-up of dogs with suspected hyperadrenocorticism.

Materials and methods: CT studies were performed with GE Lightspeed 16 slices MSHCT, Medrad Envision Injector System, GE ADW 4.1 Workstation. We considered two different groups of dogs: 40 dogs affected by non-adrenal diseases [acute orthopedic patients, otherwise healthy (bone fracture or disc herniation) n=20; miscellaneous of systemic diseases n=20], and 20 dogs affected by hyperadrenocorticism (pituitary-dependent n=17, adrenocortical-dependent n=3).

Inclusion criteria were: history, physical examination, laboratory findings (CBC, biochemical profile, urinalysis, coagulation tests), thoracic radiographs, abdominal ultrasound and appropriate endocrinological tests (ACTH stimulation test, endogenous ACTH determination, high-dose dexamethasone suppression test). Dogs were anesthetized with midazolam, remifentanil and propofol and intubated for oxygen supplementation; the apnea was induced with a remifentanil bolus after manual hyperventilation; a scan time for entire abdomen was 12-20 seconds depending on shape of dog, with a 1.25 mm slice thickness. Iodixanol (Visipaque® 320 mg I/ml) at 2 ml/kg was injected intravenously at 1.0 ml/sec infusion rate. Two series of images before and after the injection of contrast media were performed. A third delayed series (30 min. after contrast injection) was performed in a small percentage of dogs. In dogs with suspected Cushing’s Syndrome, pituitary CT studies were also carried out. The images were consequently reformatted. Pre-contrast and post-contrast attenuation values were determined.

Results: Adrenal glands and all spatial planes were recognized in every patients. In unenhanced CT images the peripheric part of the gland have a lower attenuation value than the other part of gland; not significant differences in cranial or caudal pole of gland were observed. According to our results, attenuation measures must be realized with a region of interest (ROI) as large as possible, in order to fill the gland in all its structures and complexities.

Conclusions: Unenhanced and enhanced MSHC may be useful to characterize the morphology and attenuation values of adrenal gland in dogs. Dogs affected by Cushing’s Syndrome can be recognized by different attenuation values.
Comparison Of Computed Tomography Using Iohexol And 99mTc-DTPA Scintigraphy For Determination Of Relative Canine Glomerular Filtration Rate
A.H. Lipman DVM, B.E. Hildreth III, I.D. Robertson BVSc, D.E. Thrall DVM., PhD
Department of Molecular and Biomedical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina 27606

Introduction: Glomerular Filtration Rate (GFR) is measured to assess canine renal function. Several techniques exist including inulin clearance, creatinine clearance, 99mTc-DTPA scintigraphy, and iodinated contrast medium clearance. Relative GFR can be determined by 99mTc-DTPA scintigraphy and invasive inulin clearance techniques. A CT technique using nonionic contrast medium clearance (Iohexol) has been described in humans, however, this technique has not been evaluated in the dog. Iohexol is an adequate marker of GFR as it is filtered with little or no metabolism, secretion or reabsorption. Determination of relative contrast medium filtration by both kidneys should therefore enable estimation of relative GFR. In this project, the relative GFR determined from the contrast medium CT technique was compared to relative GFR determined from 99mTc-DTPA scintigraphy.

Methods: Ten healthy dogs with no evidence of renal disease were used. Anesthesia was induced by IV Propofol bolus and maintained with a constant rate infusion (0.3mg/kg/min). Standard 99mTc-DTPA scintigraphy was used to determine relative GFR; this was compared to a CT iohexol technique. CT consisted of acquisition of transverse images through both kidneys. 10-mm contiguous slices were acquired in a helical mode followed by 5-mm slice reconstruction. An identical post contrast series was acquired after injection of 300mg/kg iohexol (300mg/ml). This dose was sufficient for opacification of the kidneys and serum iohexol clearance studies. A 20 second scanning delay after injection yielded excellent parenchymal opacification without contrast medium present in the renal pelvis. Hand drawn regions of interest (ROI) were placed around each kidney in each slice. The area in cm² and mean Hounsfield value in each slice were multiplied giving the total number of Hounsfield units per slice. These numbers were summed for each kidney pre and post contrast medium administration. The pre contrast total for each kidney was subtracted from the post contrast total as only the contrast medium, not the renal parenchyma was being assessed. Finally, a ratio of the difference in pre and post contrast total Hounsfield units for both kidneys was determined. This ratio was hypothesized to reflect relative GFR for each kidney, and to be comparable to 99mTc-DTPA scintigraphy. All dogs recovered without incident.

Results: Relative GFR determined from 99mTc-DTPA scintigraphy and the CT technique using iohexol were compared using a paired Student’s t-test. The mean relative GFR for the right kidney was 51.5% using scintigraphy and 50.8% using the CT technique. The mean relative GFR for the left kidney was 48.5% using scintigraphy and 49.2% using the CT technique. There was no significant difference in relative GFR for the right \( (P = 0.725) \) or left \( (P = 0.712) \) kidney using the two techniques.

Conclusion: The CT iohexol technique is useful for determination of relative GFR, especially where scintigraphy is not available or contraindicated, where immediate surgical intervention is warranted, or where the additional anatomic information acquired with CT is desired. Absolute total GFR can be determined using the iohexol clearance technique after the CT study has been completed.
HIGH-RESOLUTION COMPUTED TOMOGRAPHY (HRCT) OF THE NORMAL CANINE LUNG.

V.S. Johnson BVSc*, T. Schwarz DrMedVet*, M. Sullivan BVMS, PhD#. Department of Clinical Studies*, School of Veterinary Medicine, University of Pennsylvania, 3900 Delancey Street, Philadelphia, PA19104-4107, USA; Division of Small Animal Clinical Studies#, Glasgow University Veterinary School, Bearsden, Glasgow, G61 1QH, UK.

Introduction: High-resolution computed tomography (HRCT) is widely used in the assessment of human lung disease. HRCT is increasing in availability for use in veterinary patients and has great potential for imaging the canine pulmonary parenchyma. To date, there have been no descriptions of the normal canine lung on HRCT. The aim of this study was therefore to describe the normal appearance of the lung and to establish normal ranges for various anatomical parameters using this imaging modality.

Materials and methods: Forty dogs from a hospital population underwent HRCT of the lung. The dogs were assessed as having no history or clinical evidence of thoracic disease and had normal thoracic radiographs. The HRCT images were analyzed subjectively and objectively. Cross sectional areas were calculated for certain features and these were correlated with the body weight and a vertebral body measurement. CT attenuation values were obtained for all lung lobes. Statistical analyses were performed.

Results: The mean lung attenuation was -713 CT units [± SD 15]. There was no statistically significant difference in attenuation for the different lung lobes (p=0.05). Atelectasis was a common finding. Cross sectional areas were established for the caudal lobar bronchi, pulmonary arteries and veins. Caudal lobar pulmonary veins were found to be significantly larger than their corresponding arteries. Ratios were determined for the bronchial walls to external bronchial cross sectional areas and for the arterial to bronchial cross sectional areas.

Conclusions: HRCT provided excellent cross sectional images of the canine pulmonary parenchyma. It is hoped that the normal values established here will be of use in recognizing and understanding lung pathology using this imaging modality in future.
MRI FEATURES OF FELINE FIBROSARCOMAS  
F. Llabrés-Díaz  
DVM,DVR,DipECVDI,MRCVS  Animal Health Trust, Lanwades Park, Kentford, Newmarket,  
Suffolk, England, UK CB8 7UU

Purpose of the study
To present the results of a retrospective study on the MRI appearance of 21 fibrosarcomas, 1  
fibromyxosarcoma, 3 undifferentiated soft tissue sarcomas (in the absence of immunostaining), 1  
spindle cell sarcoma and 1 case of a focal interscapular injection reaction.

Methods
The MRI archives of the Animal Health Trust (November 1992 to March 2004) were reviewed and  
feline patients with superficial soft tissue sarcomas were selected. Only those cases where  
histopathology had confirmed the diagnosis were finally included in the study. The MRI scans were  
carried out using 3 different MR systems, a General Electric 1.5T system (22 cases), a Philips 0.5T  
system (1 case) and a SMIS 0.5T system (4 cases). The number of planes and type of sequences  
performed in each case were recorded. Whenever possible, a post processing subtraction study (post  
contrast T1W minus plain T1W) was performed to investigate whether this particular protocol helped  
in the MRI evaluation of this type of cases. The type of pre-MRI diagnostic procedure (incisional  
biopsy, excisional surgery) and the period between this procedure and the MRI were also noted. Cases  
where the pathology report mentioned the suspicion of a vaccine-induced fibrosarcoma were also  
listed.

Results
Study population: Twenty-six cats were originally selected. The histopathology results were as  
follows: 1 fibromyxosarcoma, 3 undifferentiated soft tissue sarcomas, 1 spindle cell sarcoma and 21  
fibrosarcomas. Only few reports mentioned the possibility of the latter being vaccine induced, even if  
the majority were or had been interscapular in location. 1 patient with an interscapular injection  
reaction was also included in the study for comparison. The 27 cats were medium to old (mean age  
9.2 years, ranging from 4 to 13 years); there were 10 neutered males and 17 neutered females. The  
most common location of the lesions was interscapular, although lesions affecting the head, neck,  
flank or tail base were also identified.

MRI findings: although all three planes (dorsal, sagittal and transverse) were not available for each  
case, images on the transverse plane were always performed. The most commonly performed  
sequences were plain T1W, T1W after the administration of paramagnetic contrast medium, with or  
without suppressed fat signal, and post processed subtraction sequences. The last two sequences were  
considered the most helpful, as all cases except one showed post contrast enhancement. The cases  
could be divided in two main groups: 1) cases where a mass was present, either because only  
incisional biopsy had been performed before the MRI or where the lesion had already recurred prior  
to imaging and 2) those where excisional surgery had been performed before the MRI and a discrete  
mass was not identified on imaging. In all cases MRI helped the clinicians to decide whether radical  
surgery was indicated and to define the limits of the surgical field. It was felt that MRI was more  
useful in those cases imaged before any extensive surgery, as in the majority of post surgical cases it  
was very difficult to define whether the MRI changes were post surgical scarring or extension of the  
previous pathology.

Discussion/Conclusions
MRI is very useful for the evaluation of feline patients presented with soft tissue sarcomas and in  
particular interscapular fibrosarcomas, where radical surgery with wide margins is recommended to  
avoid or delay local recurrence. Plain and post contrast T1W images are most useful. Both subtraction  
and post contrast fat suppressed T1W sequences are recommended for difficult cases, the advantage  
of the former being that no extra scanning time is needed. STIR sequences can also be performed, but  
better anatomical detail is provided by T1W sequences. Better results will be obtained when the MRI  
is performed after incisional biopsy rather than recent excisional surgery.
Introduction: Identification of iron accumulation in the avian liver is a diagnostic challenge. Clinical signs associated with iron overload in both mammalian and avian species are directly related to declining liver function. Specific tests are available to assess total body iron stores in mammals. In the avian species, there is a wide species variation for serum iron levels and normal reference ranges have not been well established. Liver biopsy with histologic examination of the tissue is currently the most reliable method to quantitatively measure body iron status. The risk of the procedure in the avian species limits its acceptability for use in monitoring body iron levels over time. A quantitative means of measuring body storage iron that is non-invasive, safe, accurate and readily available would be useful. Two methods that have been investigated in humans include magnetic resonance imaging (MRI) and ultrasonographic analysis of the liver. Both these modalities are available in veterinary medicine and meet the criteria of being safe, non-invasive, and readily available.

The purpose of this study was to evaluate MRI and ultrasonographic imaging methods for quantitative measurement of avian hepatic iron accumulation.

Materials and methods: Iron overload was induced by 4 intravenous injections of iron dextran at a dose of 25mg/kg at the start of weeks 1,2,3, and 4 in eight clinically healthy adult pigeons (Columbia livia). 4 additional pigeons received no iron injections. Surgical liver biopsies were performed on all iron overloaded birds at weeks 0, 2, and 6. A single liver sample was collected at week 6 on the control birds. Histological analysis, special staining, and tissue iron analysis were performed on each liver sample.

Ultrasound examination of the liver in the iron-overloaded birds was performed at weeks 0, 2, 4, and 6. No ultrasound images were collected on the control pigeons. Ultrasound images were obtained using a General Electric Logic 400 ultrasound machine equipped with a 7.5mHz linear transducer. MRI exams were performed at weeks 0, 2, 4, and 6. T1-weighted, T2-weighted, and gradient recalled echo (GRE) imaging sequences were collected. The MRI’s were performed using a 1.5 Tesla EchoSpeed Plus System manufactured by General Electric Medical Systems.

Results and discussion: Hemochromatosis was induced in all study birds. None of the pigeons showed clinical signs or symptoms of iron overload during the six-week study. No significant change in pixel intensity of the ultrasound images was seen at any point in the study. No trend in ultrasound pixel values was noted throughout the study. MRI signal intensity changes corresponded to changes in hepatic tissue iron concentration and notable histological changes. MRI signal intensity, in all imaging formats, (T1-weighted, T2-weighted, and GRE) decreases as the accumulation of iron increases. T1-weighted images were easier to analyze because of the distinct margination between different tissue types.

Introduction/Purpose: Routine staging of cancer can involve multiple procedures, some of which may be invasive and still underestimate the extent of disease. Whole body MRI may provide a non-invasive imaging procedure for staging cancer. Historically, whole-body MRI has been lengthy and potentially expensive but hardware and software advances continue to shorten the time needed for the exam. The purpose of our study was to develop a practical protocol for whole body MRI for staging cancer.

Methods: The scanning protocol was optimized using three normal, young adult Beagle dogs and a series of dogs with advanced cancer. Various imaging planes and limb positions were evaluated to determine the best viewing efficiency. All dogs were imaged in three “slabs,” or regions, including the head and neck, thorax and cranial abdomen, and caudal abdomen and pelvis. T1, T2, and STIR pulse sequences were evaluated using conventional and more rapid acquisitions. Pulse sequences and imaging planes were compared by two radiologists for overall image quality, artifacts, and imaging time. Organs, lymph nodes, and axial and appendicular bone marrow were evaluated on the basis of visibility, pattern and relative signal intensity from measured regions of interest. Lymph nodes were identified anatomically and measured (Advantage Windows Workstation 4.0, GEMS, Milwaukee, WI.)

Results: T1 sequences provided the best anatomic detail, but the least contrast differentiation between tissue types. When surrounded by fat, lymph nodes were well visualized and had similar intensity to muscle. Appendicular yellow (fatty) bone marrow was hyperintense to muscle. T2 sequences provided better tissue contrast. Lymph nodes and bone marrow had variable signal intensity depending on fat content. STIR sequences had the greatest contrast differences between organs. Lymph nodes and some abdominal organs were very hyperintense relative to the suppressed fat. Normal appendicular marrow was relatively isointense to muscle. Lymph nodes that were routinely visualized in the normal dogs included the submandibular, medial retropharyngeal, superficial cervical, and iliosacral lymph nodes. Smaller, normal lymph nodes could not usually be detected.

Diffuse neoplastic lung infiltrate, bone marrow infiltrate, lymphadenomegaly and various mass lesions in the dogs with advanced stage cancers were best depicted by a combination of T1 and STIR pulse sequences.

Discussion/Conclusions: A whole body technique has been established that takes approximately 45 minutes. Based on initial experience in dogs with advanced cancer, whole-body MRI has potential value as an imaging modality for staging cancer. It is particularly helpful in determining bone marrow involvement, lymph node enlargement, and mass characterization. Ongoing studies of abnormal dogs are being performed to further evaluate detection of cancer lesions using this protocol.

Introduction: The diagnosis of middle ear disease can be challenging, especially in dogs with chronic otitis externa. Two non-invasive modalities commonly used for evaluating dogs with suspected middle ear disease are conventional radiography and computed tomography (CT). Previous studies comparing these imaging modalities to surgical findings in dogs did not include a comparison of imaging and surgical findings with histopathology of excised tissues. Recent advancements in CT scanning technology may allow improved visualization of middle ear pathology. The use of thinner slices may also improve diagnostic sensitivity for CT over what was previously reported. The purpose of this study was to compare CT and conventional radiography for diagnosing the presence and severity of middle ear disease, and to evaluate the effect of imaging modality on inter-rater variability.

Materials and Methods: Clients that presented their dogs for treatment of ear disease that included a total ear canal ablation (TECA) were solicited to participate in the study. All participating dogs were required to have a lateral or ventral bulla osteotomy with histopathologic sample submission from at least one bulla to be included in the study. In addition, three dogs without history of otic disease and without evidence of otitis externa on otoscopic exam were recruited. A total of 33 dogs were examined using conventional skull radiographs and CT. Three raters of varying experience levels independently evaluated the radiographs and CT images in random order. A visual analog scale method was used for scoring certainty and severity of middle ear disease. Raters were blinded to surgical and histopathologic findings. Surgical findings were recorded intra-operatively by use of a questionnaire. Bulla lining samples were obtained and submitted for routine histopathology. Samples were evaluated by a single pathologist, who also used a visual analog scale system to score certainty and severity of middle ear disease. Findings from the two modalities were then compared to histopathology and surgery findings. Inter-rater variance of scores for imaging characteristics and overall presence of middle ear disease was also tabulated.

Results: Findings from both modalities agreed more closely with surgical findings than with histopathology findings. With either surgery or histopathology as the gold standard, CT was more sensitive and as specific as radiographs for predicting presence and severity of middle ear disease. Overall severity of middle ear disease was lower in the right versus the left ears. When the results of the left and right bulla were analyzed separately, we found that CT inter-rater variance of middle ear certainty was 217.04 while radiographic variance was 126.14 on the side with lower severity estimates. Both radiography and CT were more accurate for predicting the severity of the disease process than its presence.

Conclusion: The results of the study indicate that CT is more accurate and reliable than radiography in diagnosing middle ear disease for dogs with chronic otitis externa, but only when severity of disease is moderate or high. With low severity of disease, reader diagnostic certainty for both modalities becomes more variable.
The purpose of this study was to demonstrate the potential for magnetic resonance (MR) imaging in the diagnosis of cranial nerve (CN) disorders in dogs. The study summarizes all the canine cases that displayed CN signs and received an MR at Washington State University Veterinary Teaching Hospital from January 1998 to August of 2003. Additional cases were provided from Iams Pet Imaging Center and private practice referrals.

Relevant normal canine CN anatomy was documented with a concurrent series of MR images labeled for reference. Cases are presented and corresponding CN lesions are shown on MR images. Cases documented include two CN II lesions, two cases of CN III masses, eleven cases with CN V lesions, two cases of a mass in the area of CN VII and VIII, and two cases of CN VIII masses. In addition, two dogs presented for CN signs and did not have a lesion on MR. Of the 21 total cases, none have been previously published.

In this study the sensitivity of MR at displaying CN lesions was 93%, and the positive predicted value of these findings ranged from 83-100%. MR characteristics of the lesions confirmed by histology are presented for interpretation of future CN lesions in veterinary medicine. These findings are compared and contrasted to findings in the human medical field.

The study included seven cases in which a CN lesion was removed by surgery or necropsy. Six of those cases had reports confirming a lesion of the suspected CN. The MR images of CN neuritis and CN nerve sheath tumors displayed a contrast enhancing mass with or without a more diffuse enlargement of the affected nerve. Information suggested that an enhancing CN, without an associated mass lesion, should be diagnosed as neuritis and not neoplasia. However, compatible clinical signs must be present as bilaterally enhancing and symmetric CNs have been noted in normal patients. Atrophied and enhanced masticatory muscles were seen with CN neuritis or neoplasia and were associated with denervation of CN V. A decrease in extravasation of contrast was also noted following surgical removal of a lesion.

Early diagnosis and treatment of CN lesions may lead to a more favorable prognosis. MR examination of any dog with CN signs is likely to yield a visualized lesion and narrow the differential diagnoses. The ranking of differential diagnoses, such as inflammation versus neoplasia, may need to be based on signalment, history, and other examination or laboratory findings.
COMPUTED TOMOGRAPHY FOR IDENTIFICATION OF EARLY THIRD METACARPAL TRAUMATIC PALMAR SUBCHONDRAL BONE LESIONS.

H.L. Thomas BVMS DVSc, L.D. Galuppo DVM, E.R. Wisner DVM, S.M. Stover DVM PhD, H.E. DeCock DVM PhD, University of California, Davis, California, 95616.

Introduction/Purpose: Traumatic subchondral bone disease is a common degenerative condition involving the palmar surface of the articular condyle on the distal aspect of the third metacarpal or metatarsal bone of horses in race training. Early stages of the disorder are reversible; however, progression of this condition invariably leads to irreversible osteoarthritis. Currently, standard radiographic techniques are not sensitive enough to detect early, potentially reversible, changes. Therefore, a need exists for a more sensitive diagnostic technique. The major objective of this study is to assess the usefulness of computed tomography for detection of early, potentially reversible, traumatic subchondral bone lesions affecting cadaver fetlock joints from racehorses. Ultimately, this will facilitate earlier disease detection in live horses.

Methods: Twenty, third metacarpal bones were selected from racehorses that died or were euthanized at California racetracks for reasons unrelated to the metacarpophalangeal joints. On gross examination, cartilage lesions were classified as no lesions, mild, moderate or severe. Five bones were selected in each classification. The articular surface of each bone was photographed before a 125° DP radiograph was made. Radiographic evidence of subchondral bone changes was graded as normal, mild, moderate or severe. CT examination of each bone was then performed. 1mm transverse slices were made of the entire condyle, including the articular surface. A potassium phosphate standard was included with each limb during CT imaging for quantitative analysis of bone density. Two, 5 mm thick slices centered on the most common site of cartilage erosions in the lateral condyle, were made with a bandsaw. The two slices each included half of the gross lesion and were in identical locations for all limbs. One slice from each condyle was embedded in methylmethacrylate and processed for microradiograph production. The second slice from each condyle was processed for staining with hematoxylin and eosin, before microscopic examination.

Results: Early palmar subchondral bone lesions were not consistently identified on the 125°DP radiograph; however, they were clearly visible on the CT images. The CT images showed subchondral bone defects, with underlying sclerosis. The CT images also allowed assessment of the trabecular bone structure. All of these CT findings correlated well with histopathology and microradiography.

Discussions/Conclusions: Orthopedic disease, including osteoarthritis, is an enormous source of economic loss to the equine industry every year. The results of this study show that CT is a more sensitive method than plain radiographs, for detection of early third metacarpal traumatic palmar subchondral bone lesions. The results will facilitate earlier disease detection and more accurate prognostication. This will allow for management and treatment of early changes to promote resolution of the disease and thus prevent the progression of disease to irreversible osteoarthritis. Consequently, fewer racehorses will suffer from fetlock arthritis and losses to the equine industry could be reduced.
SPIRAL CT ANGIOGRAPHY OF PULMONARY ARTERY TREE IN DOGS: DEVELOPMENT AND USE OF TEST BOLUS INJECTION PROTOCOL  A.S. Tidwell, DVM, J. Welcome, BS, DVM, L.M. Kinney, BS, CVT, LATG. Tufts University School of Veterinary Medicine, North Grafton, MA 01536

Introduction: Spiral CT angiography permits scanning during optimal contrast medium opacification, thus eliminating the need for selective catheterization. A test bolus injection technique has been described in people to facilitate scanning during peak enhancement of the vessel of interest.\(^1\) The purpose of this study was to develop a protocol for spiral CT angiography of the pulmonary arteries and other thoracic vessels in 5 dogs using a modified test bolus injection technique for determining the optimal scan time delay.

Methods: Five healthy research dogs (4 mixed breed, body weight range= 22-25 kg; 1 beagle= 11kg) were anesthetized and scanned using a Picker Venue PQ 5000\(^{TM}\) spiral CT scanner. A non-contrast CT scan of the thorax was performed with the dogs in ventral recumbency using 120 KV, 300mA, and a pitch factor 1.25 to obtain images with 3mm thickness and 2mm reconstruction interval. After the non-contrast scans, the optimal contrast scan delay was determined using a modified test bolus injection technique. Serial single level (i.e., no table movement) transverse images were obtained at four different sites during the administration of four 10-15 ml test boluses of 60% diatrizoate meglumine (Hypaque-60, 282 mg iodine/ml) through an 18 gauge, Jelco-type cephalic catheter. Site #1 was positioned at the aortic arch; site #2 at the bifurcation of the left and right pulmonary arteries off the main pulmonary trunk; site #3 at the left atrium; site #4 at the caudal vena cava. For each test injection, contrast was administered at a rate of 3 ml/second with a maximum PSI of 300 using a Medrad Vistron CT pressure injector. Each series of transverse images were acquired beginning immediately at the onset of injection at a rate of 1 image per 2 seconds. Hounsfield units (HU) were generated over the different sites using region-of-interest (ROI) cursors in order develop a time-density curve. Based on this curve, the time to peak enhancement or opacification was determined for each vessel in question. This was considered the optimal scan delay. Heart rate and respiratory rate were recorded every 30 seconds to determine if they influenced circulation times. A spiral post contrast scan of the pulmonary artery tree (from 1 slice cranial to the pulmonary outflow tract extending caudally to the diaphragm) was then performed using the same scanning parameters as the non-contrast scan, but after the administration of 1 ml/kg of body weight of contrast at a rate of 3 ml/sec (except in one dog where 2.2ml/kg was given). Injection was begun and scanning was initiated after the optimal scan time delay (as determined by the test bolus injection for site 2) minus 5 second spiral ramp up time. This permitted scanning to occur in spiral mode through the region of interest (ie, pulmonary artery tree) near its peak opacification time.

Results: Optimum scan time delay for the pulmonary artery (site 2) ranged from 5-10 sec in the larger dogs and was 5 sec in the beagle (range= 5-10 sec, mean = 6.8). Other values: site 1, range 12-17 sec, mean= 14.6; site 3, range 8-13 sec, mean=10.8; site 4, range 32-59 sec, mean 41.4. Heart and respiratory rates did not appear to influence circulation times. The test bolus injection technique did allow for good opacification of the pulmonary artery tree, although uneven opacification of some of the branches was noted.

Conclusion: Although limited by the small sample number, variation in circulation times for different vessels and variation between individuals merits the use of a test bolus technique during spiral CT angiography of the thoracic vasculature.

Introduction: Differentiation between rhinitis and sinonasal neoplasia in feline patients can be challenging because of non-specific clinical signs. CT has been found to be more sensitive and accurate in demonstrating the extent of sinonasal disease than conventional radiography in dogs and humans. At the time this study was initiated, no published reports were found in which clinical and CT findings were compared with histological diagnoses in cats with suspected sinonasal disease. Since initiation of this study, one such report has been published (Schoenborn et al, Vet Rad & US, 2003; 44:185-195). The purpose of this retrospective study was to determine the association of clinical and/or CT characteristics with rhinitis or sinonasal neoplasia in cats.

Methods: From 1995 to 2002, medical records of feline patients with suspected sinonasal disease were reviewed. Cats evaluated with CT and nasopharyngeal endoscopic examination with nasal biopsy and histopathology were selected for inclusion in the study. Clinical data recorded were: age, gender, body condition score, duration of clinical signs, presence, lateralization and character of ocular and nasal discharge, presence of respiratory stertor or sneezing, endoscopic findings, method of biopsy, and histologic diagnosis. Cats were assigned to either neoplastic or non-neoplastic groups based on results of histopathology. A single radiologist re-evaluated the CT exams of all cats in random order, without knowledge of final diagnosis. Data recorded from each CT study were: presence and lateralization of abnormal soft tissue in the nasal cavity and paranasal sinuses, retrobulbar space and nasopharynx, and osteolysis or hyperostosis of the paranasal bones, turbinates, and nasal septum. Frequencies of clinical and CT characteristics were calculated by group, and odds ratios were calculated to identify characteristics associated with neoplasia.

Results: A total of 43 cats met inclusion criteria, with 15 in the neoplastic and 28 in the non-neoplastic groups. Chronic mucopurulent and variably hemorrhagic types of nasal discharge were common in both groups. Unilateral ocular discharge was more frequently observed in cats with neoplastic (40%) than with non-neoplastic disease (7%). Seventy-nine percent of cats with neoplasia had visible masses on retroflex pharyngoscopy versus 15% in the non-neoplasia group. Non-neoplastic nasopharyngeal masses included inflammatory polyps and mucosal hyperplasia. The majority of cats with neoplasia had evidence of paranasal bone lysis (86%) and extra-sinonasal extension of disease (60%), versus 36% and 7% of cats with non-neoplastic disease respectively. Unilateral lysis of the ventral maxilla (OR=28.8), dorsal maxilla (OR=8.3), and lateral maxilla (OR=6.9) were significantly associated with neoplasia. Lysis of maxillary turbinates was a non-specific finding. Lysis of ethmoturbinate (OR=11) and unilateral (OR=6.7) or bilateral lysis of the vomer bone (OR=4.5) were highly associated with neoplasia. Most cases with neoplasia had unilateral opacification of frontal (OR=10.4) and sphenoid sinuses (OR=15.3). Bilateral erosion of the orbital lamina (OR=4.1), abnormal retrobulbar soft tissue (OR=12.2), and ipsilateral ocular discharge (OR=9.6) were also significantly associated with neoplasia. Cats with non-neoplastic disease did not share this combination of characteristics.

Conclusions: Findings from this study were consistent with those previously reported by Schoenborn et al. In addition, the presence of ethmoturbinate lysis, unilateral paranasal sinus opacification, and unilateral (ipsilateral) ocular discharge were found to be associated with neoplasia.
MAGNETIC RESONANCE IMAGING ACCURATELY DETERMINES SYNOVIAL FLUID VOLUME IN CANINE STIFLE JOINTS.

R Kijowski, MD1, KA Buckwalter, MD, MS2, WR Widmer, DVM, MS3, KD Brandt, MD2, JL Rankin, RTR2, ME Albrecht, BS1 University of Wisconsin1 and Indiana University2 Schools of Medicine and Purdue University School of Veterinary Medicine3

Purpose: Surgical destabilization of the canine stifle joint results in a well-documented experimental model of osteoarthritis. This model produces pathologic changes that closely resemble those of spontaneous osteoarthritis in man and animals and is used to evaluate new drugs for the treatment of osteoarthritis. Most anti-arthritic drugs are anti-inflammatory agents that ameliorate synovial changes and reduce pain. Previously, response to drug therapy in clinical trials has been measured by subjective clinical methods, including grade of lameness, force plate analysis and radiography. A potential measure of the degree of inflammation within an osteoarthritic joint is synovial fluid volume. Studies have shown a direct correlation between synovial fluid volume and the amount of joint inflammation in patients with osteoarthritis and rheumatoid arthritis.1,2 We propose that magnetic resonance (MR) imaging can be used to accurately measure synovial fluid volume and may be a proxy for inflammatory changes in an osteoarthritic joint.

Methods: Four normal canine cadaveric stifle specimens were injected with known amounts of saline and imaged with a 1.5T MR scanner. Following baseline imaging, various increments of saline were introduced into the joint space via an angiographic catheter. After each injection a transverse, FSEIR, interleaved MR scan was obtained using the following scan parameters: 15 cm field of view, 4 mm slice width with a 1 mm gap, repetition time of 2000-5000 msec, echo time of 34 msec, inversion time of 150 msec, echo train of 8, 192 phase encodes, 256 matrix, and 2 signal averages. The transverse images were extended proximally and distally to identify all the fluid within the stifle joint. Images were archived and later analyzed on an OminiPro 3D workstation. The volume for each slice was calculated by multiplying area times slice thickness. The volume of each slice was added to determine the total synovial volume for each increment of saline injected. The volume of fluid measured by MR was compared to the actual volume of fluid injected in each stifle joint and statistical analysis was performed.

Results: The imaging protocol provided excellent image contrast and resolution, allowing visualization of the boundaries of the joint space and injected fluid. Data regarding volume of saline injected and volume measured by MR are presented in table 1. In all specimens, the volume of saline injected and that determined with MR compared favorably (coefficient = 0.9891). Both small (<1 cc) and larger volumes (1-7 cc) were accurately measured by MR.

Table 1. Linear regression analysis

<table>
<thead>
<tr>
<th>Actual volume (cc)</th>
<th>MR volume vs. actual volume</th>
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<tr>
<td>0</td>
<td>y = 1.048x - 0.0906</td>
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<tr>
<td>1</td>
<td>R² = 0.9891</td>
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<td>8</td>
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</table>

Conclusion: MR can provide an accurate non-invasive measure of synovial fluid volume in canine stifle joints.

Introduction: Clinical management of canine and feline urinary calculi can be facilitated once the precise chemical composition of the calculus is known. Currently, determination of chemical composition requires obtaining a sample urolith for chemical analysis. The purpose of this study was to ascertain the feasibility of using computed tomography (CT) to analyze and determine the chemical composition of urinary calculi in vivo.

Methods: One hundred four canine and eighty nine feline uroliths of known type and composition were obtained from the Minnesota Urolith Center. Uroliths were deemed chemically pure (100% of each mineral type) based on quantitative analysis. Individual uroliths were placed in phantoms containing saline. Spiral computed tomography was performed on the phantoms using 3 mm slices with a 2 mm table feed at 130 kv and 83 mA. For analysis, a soft tissue window with a level of 500 and a center of 100 was chosen. CT attenuation values were measured using circular, free-form and single point regions of interest drawn on slices in which stones were seen in their greatest diameter.

Results: Canine uroliths analyzed were ammonium acid urate, calcium oxalate monohydrate, calcium oxalate dihydrate, cystine, and struvite. Differentiation between stones and consequently determination of chemical composition could not be made based on CT attenuation values obtained. Feline uroliths analyzed were ammonium acid urate, calcium oxalate monohydrate, cystine and struvite. Cystine stones could be differentiated from ammonium acid urate, calcium oxalate monohydrate, and struvite stones. The latter three could not be differentiated from one another.

Conclusion: CT attenuation values obtained using the scanning parameters in this study could not differentiate between any of the canine uroliths examined. Of the feline uroliths examined, only the chemical composition of cystine stones could be ascertained based on CT attenuation values. Further studies using varied collimation widths and energies may allow further differentiation and determination of chemical composition of canine and feline uroliths.
COMPUTED TOMOGRAPHY-GUIDED SAMPLING OF INTRA-THORACIC LESIONS IN THIRTY DOGS AND CATS. Lisa J. Zekas, D.V.M., Jason T. Crawford, D.V.M. School of Veterinary Medicine, University of Wisconsin-Madison, WI 53706

Introduction/Purpose: Computed tomography (CT)-guided sampling for diagnosis of thoracic disease has been reported, with the most common complications being pneumothorax and hemorrhage. The purpose of this study was to describe the diagnostic results of CT-guided fine-needle aspirates (FNA) and core biopsies (Bx) in a larger sample of patients than previously reported and to determine the frequency and severity of associated complications.

Methods: Records and images were reviewed for patients that had CT-guided FNA or Bx of an intra-thoracic mass. Recorded data included signalment, whether normal lung was penetrated, lesion location, depth of the lesion in the direction of sampling, length of normal lung penetrated and results of clotting profiles. Cytologic and/or histopathologic results were listed as non-diagnostic or diagnostic and categorized as neoplasia or benign disease (inflammatory or infectious). Complications (pneumothorax or hemorrhage) identified by CT or clinically were graded as mild, moderate or severe. CT-guided aspirates and biopsies were performed as previously described (Tidwell and Johnson 1994).

Results: Twenty-seven dogs, 2 domestic cats and a cougar met inclusion criteria. Five lesions were mediastinal and 25 pulmonary. Twelve patients (40%) had a FNA only, ten (33%) Bx only and eight (27%) had both. Cytology on 13 of 20 (65%) FNA samples was diagnostic (1 benign, 12 neoplastic), while 7 (35%) were non-diagnostic (1 neoplastic, 1 benign, and 5 lesions with no final diagnosis). Fifteen of 18 (83%) Bx samples were diagnostic (3 benign, 12 neoplastic), while 3 (17%) were non-diagnostic (one inconclusive, 2 misinterpreted as benign). FNA and Bx agreed on 7 of the 8 animals which had both procedures. One sample was interpreted as benign with Bx and neoplastic with FNA. Samples from 3 of the 21 neoplasia lesions were interpreted as inconclusive (1 Bx, 1 FNA) or incorrectly misdiagnosed as benign (1 Bx), subsequently diagnosed with surgery / necropsy. Complications were noted on CT images in 13 (43%) patients (pneumothorax in 8, hemorrhage in 9 and both in 4). No clinical complications were seen in any patient. One patient developed a body wall hematoma after a biopsy. Normal aerated lung was crossed in 20 patients (67%), the width ranging from 2-35 mm (mean 15.1 mm). Normal lung was penetrated in all animals in which pneumothorax or hemorrhage was identified. There was a significant correlation between penetration of normal lung and the occurrence of CT identified complications (p=0.0003). The average length of normal lung penetrated for animals which developed pneumothorax was slightly longer than those that did not, 14.3mm and 8.5mm respectively, but this was not statistically significant. Normal clotting profile examinations were performed in 4 (44%) animals with identified hemorrhage. Type of disease (neoplastic vs benign), location of lesion and size of lesion did not correlate with complications.

Conclusions: CT-guided FNA or Bx is a useful and safe procedure for obtaining diagnoses of intra-thoracic lesions, especially neoplasia. FNA was non-diagnostic more often than biopsy. Pneumothorax and hemorrhage are common when normal lung is penetrated to reach the lesion, but clinical manifestations were not noted in this series.
ULTRASOUND GUIDED TRANSPLENIC PORTAL SCINTIGRAPHY WITH $^{99m}$TcO$_4^-$ AND ITS COMPARISON TO PERRECTAL PORTAL SCINTIGRAPHY. R.C. Cole
D.V.M., F. Morandi D.V.M., M.S., J. Avenell B.S., G.B. Daniel D.V.M., M.S. University of Tennessee College of Veterinary Medicine, Knoxville, TN 37901

Introduction: Per-rectal portal scintigraphy (PRPS) is a non-invasive, rapid, highly sensitive and specific method of diagnosing portosystemic shunts. PRPS does not consistently permit morphologic description of the shunt vessel or differentiation between single and multiple shunts. PRPS is limited by poor radioisotope absorption and the resulting poor image count density. The purpose of this study was to: 1) establish a technique for ultrasound-guided percutaneous transsplenic portal scintigraphy (TSPS) using $^{99m}$TcO$_4^-$ 2) evaluate portal vein morphology 3) compare the radiation exposures for TSPS versus PRPS and 4) to compare the quality of numerical data from the TSPS versus PRPS.

Methods: Eight, juvenile female intact beagle dogs weighing 3.6 to 4.5 kg underwent both PRPS and TSPS (48hr separation between studies) after initial screening tests including blood work, ultrasound and radiographs. Dogs were sedated with intravenous acepromazine and butorphanol for both scintigraphic studies. All PRPS studies were done according to a previously established protocol using 425 ± 36 MBq (mean ± SD) of $^{99m}$TcO$_4^-$. For all of the TSPS studies, the dogs were positioned in right lateral recumbency over a gamma camera. $^{99m}$TcO$_4^-$ (57 ± 13.91 MBq) was injected into the splenic parenchyma through a 22G, 1.5 inch needle via ultrasound guidance. A dynamic acquisition was initiated after needle placement and 1-2 seconds prior to injection of the $^{99m}$TcO$_4^-$. The frame rate was 4frames/second for 5 minutes. Shunt fraction values and total organ counts were compared between the two studies. Absorption of the radioisotope from the spleen and colon were calculated. Transit time of the $^{99m}$TcO$_4^-$ from the liver to the heart was determined for the TSPS studies. Radiation exposure (mR/hr) and radiation dose measurements (mRem/hour) were taken for each dog after each procedure.

Results: There was a significantly lower dose of $^{99m}$TcO$_4^-$ given and significantly higher total counts recorded during the TSPS studies compared to the PRPS studies. The total counts for the TSPS and PRPS were 7120 ± 4386 and 830 ± 523 (mean ± SD) respectively. The percent absorption of the radioisotope from the spleen was 52.50 ± 19.06%, compared to 9.23 ± 5.66% (mean ± SD) for the colon. The transit time calculated for the TSPS studies was 7.03 ± 2.28s (mean ± SD), and this value was used to calculate shunt fractions for the TSPS. In all studies, it was possible to clearly identify the splenic and portal vein. The exposure levels of the dogs following TSPS were significantly lower than after PRPS, regardless of the method of measurement.

Conclusion: TSPS appears superior to PRPS as a method to image the portal venous system. This test was easy to perform, rapid, and provided a nuclear angiogram of the portal vasculature in normal dogs. This test provides significantly higher count density within the liver and heart, while at the same time significantly reducing radiation exposure to the patient and staff. TSPS represents a valid alternative diagnostic test for animals with suspected portosystemic shunts.
Introduction: Ultrasound-guided percutaneous transsplenic portal scintigraphy (TSPS) using $^{99m}$TcO$_4^-$ can be used to image the portal venous system in normal dogs. When this test was compared to per-rectal portal scintigraphy, it proved to provide higher count density, consistent nuclear angiograms of the splenic and portal vein, and significantly decreased radiation exposures. TSPS was used to diagnose portosystemic shunts in dogs.

Methods: From November of 2003 to March of 2004, twenty-two TSPS studies were performed at UTCVM. 40.7 to 136.16 MBq of $^{99m}$TcO$_4^-$ was injected into the splenic parenchyma with ultrasound guidance. A dynamic acquisition at a frame rate of 4 frames/second for 5 minutes was initiated after placement of the needle and 1 to 2 seconds prior to injection.

Results: Of the twenty-two studies attempted, twenty-one were of diagnostic quality. The one nondiagnostic study was the result of intraperitoneal rather than intrasplenic injection. Of these twenty-one cases, fifteen had surgical conformation and the surgery reports were compared to the scintigraphic results. The following table summarizes the surgical findings:

<table>
<thead>
<tr>
<th>Portoazygos</th>
<th>Intrahepatic</th>
<th>Splenocaval</th>
<th>Portocaval</th>
<th>Unclassified</th>
<th>Portophrenic</th>
<th>Multiple</th>
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<tr>
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Three patterns were recognized on the scintographic images: 1) Portoazygos shunts - the radioactive bolus traveled dorsally, running parallel to the spine and entering the dorsal area of the heart, 2) Single Portocaval shunts - the radioactive bolus ran from the area of the portal vein/splenic vein junction in a linear fashion toward the caudal vena cava and heart, 3) Multiple shunts - the radioactive bolus could be seen in discrete shunt vessels in a variety of locations followed by activity within the heart. There were no distinguishing features between intra and extrahepatic shunts.

Conclusion: TSPS allowed for the positive identification of portosystemic shunt(s) in all fifteen with surgical conformation. Furthermore, this test allowed the clinician to distinguish between single and multiple shunts, and differentiates between a shunt entering the caudal vena cava and aportoazygos shunt. This test has replaced per-rectal scintigraphy for the diagnosis of portosystemic shunts at our institution. Further studies will be needed to determine if there are additional distinguishing patterns for the different types of portosystemic shunts.
DETERMINATION OF RELEASE CRITERIA FOR I-131 THERAPY CATS

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INTRODUCTION/PURPOSE: Radioactive iodine (I-131) therapy represents the current gold standard treatment option for feline hyperthyroidism. At present, release criteria for treated cats are non-uniform, poorly standardized, and largely extrapolated from experiences in treating humans with hyperthyroidism. At our institution, the duration of radiation isolation confinement has been determined by a < 2 mrem/hr (20uSv/hr) dose rate at patient surface resulting in an average total hospitalization period of 14 days. Hospitalization fees comprise 35% of the total cost of therapy and substantial owner anxiety may occur while they are separated from their pet. The objective of the present study was to prospectively collect feline patient dose rates and owner demographic data that could be analyzed to determine client exposure. Resulting data has been submitted to the Iowa Department of Public Health, Bureau of Radiological Health to support a change in our licensure and permit cat hospitalization time to be decreased.

METHODS: The owners of 30 hyperthyroid cats treated with radioactive iodine were given a 13-item questionnaire at the time of discharge to be completed on-site. This form evaluated a spectrum of demographic parameters including owner age (e.g., adults versus minors), the estimated time that the owner would spend daily in close physical contact with their cat (petting, grooming, holding), whether or not cats were allowed to sleep with the owners, if cats were confined entirely indoors or spent time outdoors, and whether indoor-confined cats were confined to a single room or allowed access to all parts of the house. Survey completion time was approximately 10 minutes. Owner responses were tabulated and statistically integrated with patient dose rate data obtained at patient surface, 1 foot and 3 foot distances.

RESULTS: Cats were treated with an average of 4 mCi (148 MBq) of I-131; range 3-4.5 mCi (111-167 MBq). The average effective half-life of I-131 in the cats was 2.3 days. The vast majority (> 96%) of households surveyed were comprised solely of adult (> 18 years of age) owners. Eighty-seven percent of owners planned to spend 6 or fewer hours daily in close physical contact with their pet. Fifty-seven percent planned to allow the cat to sleep with a member of the household. Only 13% of owners planned to spend 12 or more hours daily in close physical contact with their cat; most owners in this group stated that their cat slept on the bed. Lastly, the majority (77%) of indoor cats were not confined to a single room but were allowed to roam throughout the house.

DISCUSSION/CONCLUSIONS: The final release criteria recommended following statistical analysis of the patient dose rate data with respect to owner contact time is a dose rate of 5 mrem/hr (50uSv/hr) at one foot (30 cm). These criteria are based on maintaining a total effective dose equivalent to any member of the general public to less than 100 mrem (1mSv). A minimum 3 day confinement in radiation isolation will be required, with the owners restricted from sleeping with the pet for seven days post-release. These revised guidelines will sharply reduce the length of hospitalization subsequent to I-131 injection at our institution.
EFFECTS OF METHIMAZOLE ON THYROID GLAND UPTAKE OF $^{99m}$Tc-PERTECHNETATE IN HYPERTHYROID CATS. AJ Fischetti,1 WT Drost,1 SP DiBartola,1 DJ Chew,1 PA Schenck,2 C Meadows.3 Departments of 1Veterinary Clinical Sciences and 3Veterinary Preventive Medicine, The Ohio State University, Columbus, OH and 2Diagnostic Center for Population and Animal Health, Michigan State University, East Lansing, MI.

Introduction: Thyroid uptake of $^{99m}$TcO$_4$ is increased when normal cats are made hypothyroid using the anti-thyroidal drug, methimazole. The effect of thyroid $^{99m}$TcO$_4$ uptake in hyperthyroid cats made euthyroid with methimazole is unknown.

Methods: Fifteen hyperthyroid cats underwent thyroid scintigraphy using $^{99m}$TcO$_4$ before and after approximately 36 days (range, 28-56 days) of methimazole (2.5 mg BID). We hypothesized that methimazole would increase thyroid uptake of $^{99m}$TcO$_4$. Quantitative analysis of thyroid gland uptake included thyroid to salivary gland ratio (T:S) 20 and 60 minutes after injection and percentage thyroid uptake of injected dose (% uptake) 20 and 60 minutes after injection. The maximum (Max) and average (Avg) thyroid densities were used to calculate T:S ratios.

Results: The cats were 13 ± 3.2 years old; seven male and eight female. Before treatment, four cats had unilateral hyperthyroidism and 11 cats had asymmetric, bilateral hyperthyroidism. Median total serum thyroxine (tT$_4$) concentration before treatment was 6.9 µg/dl (range, 4.1-15.0 µg/dl) and after treatment was 1.6 µg/dl (range, 0.3-4.1 µg/dl). Thyroid stimulating hormone concentration was undetectable before treatment with methimazole and increased in four cats after treatment. All quantitative methods of thyroid uptake analysis correlated with tT$_4$ concentration before treatment ($r^2 = 0.74-0.85$). Thyroid uptake did not significantly increase after treatment (sign test $P > 0.1$) (Table). Subjectively, two unilaterally hyperthyroid cats became bilaterally asymmetric hyperthyroid after treatment. These two cats had the greatest increase in thyroid stimulating hormone after treatment.

Conclusions: Methimazole treatment does not significantly affect the scintigraphic diagnosis of hyperthyroidism in cats. The change from unilateral to bilateral hyperthyroidism may have clinical relevance if surgical correction is considered.

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ACCURACY OF ELEVATED THYROID: SALIVARY RATIO DURING SUBCUTANEOUS THYROID SCINTIGRAPHY FOR DIAGNOSING FELINE HYPERTHYROIDISM  
Richard B. Page, DVM, Peter V. Scrivani, DVM, Nathan L. Dykes, DVM, Hollis N. Erb, DVM, PhD, Cornell University, Hospital for Animals, Ithaca, New York, 14853-6401

Introduction:
The purpose of this study was to determine the accuracy of detecting an elevated thyroid: salivary ratio (T: S) during subcutaneous thyroid scintigraphy (SQTS) for diagnosing hyperthyroidism in cats suspected of having that disease.

Methods:
SQTS was performed by injecting pertechnetate (4 mCi, SQ) in the right-dorsal-lumbar region. Static-acquisition images were obtained 20-minutes after injection by positioning the cat in sternal recumbency over a gamma camera with a Low Energy High Resolution parallel-hole collimator. The images were acquired for 250,000 counts using a dedicated nuclear-imaging computer. Regions of interest were drawn and the T: S was calculated.

Results:
To date, the sample population consisted of 11 cats; 8 (73%) of these cats were determined to have hyperthyroidism based on a serum total thyroxine (TT4) level greater than 4 ug/dl. Using a Wilcoxon Rank Sum test, a significant difference (p<0.01) in the T: S was detected between cats with and without hyperthyroidism. Using a decision criterion of 1.0, the preliminarily assessment of an elevated T: S during SQTS appeared highly sensitive and moderately specific for feline hyperthyroidism; whereas a cut-point of 5.0 appeared moderately sensitive and highly specific. However, the 95% confidence intervals were large due to sampling variability.

Discussion:
The study will continue until a reasonable number of cats with and without hyperthyroidism are enrolled. Additional decision criteria and predictive values will be evaluated.
COMPARISON OF THE CELLULARITY OF ULTRASOUND GUIDED BIOPSY SAMPLES USING SPINAL AND STANDARD NEEDLES. JA Feleciano, DVM, M Menard, DVM, MS, PhD, M Papageorges, DVM, MS, PhD, J Hanson, DVM, J Tepavich, DVM, E Girard, DVM, VDIC, 16900 SE 82nd Dr., Clackamas, Oregon, 97015

Introduction: Ultrasound guided fine needle biopsy is a commonly used non-invasive procedure that can provide a high diagnostic yield. A modified non-aspiration fine needle biopsy technique using spinal and standard needles that increases cellularity of the samples has been described. In our practice, samples obtained with long spinal needles appeared to have higher cellularity, especially for the liver. The purpose of this study is to determine if there is a significant difference in cellularity between samples obtained with spinal needles and standard needles.

Methods: 503 fine needle biopsies were performed by three board certified radiologists, a certified radiology resident, and a third year radiology resident. The biopsied organs included liver (229), spleen (68), kidney (13), pancreas (13), masses (115), intra-abdominal lymph nodes (51), soft tissue/muscle (3), prostate (7), and urinary bladder (4). The biopsies were obtained by ultrasound guidance using a non-aspiration technique. The biopsy needle was attached to an extension set which was attached to a 12 ml syringe that was pre-filled with 5 ml of air (1-2 ml for kidney biopsies). The needle was directed with ultrasound guidance into the target tissue. Once the needle was within the “target” tissue the needle tip was moved back and forth 8 to 10 times to pack a cellular slurry into the needle. The sample was rapidly expelled onto a microscope slide and a gentle squash preparation was made. Samples were obtained with 1 inch 22 gauge standard and spinal needles, 3 inch 22 gauge standard, and 3 inch 22 gauge spinal needles. The choice of needle length was decided by the operator and was usually determined by depth of target tissue. The slides were labeled in a randomized fashion and the pathologist was blinded to the needle type. A board certified clinical pathologist reviewed the slides and the cellularity of the sample was graded on a scale of 0 to 5. A grade of 0 represented no cells of the target tissue and a grade of 5 represented a sample of excellent cellularity.

Results: Liver biopsies obtained with 3 inch spinal needles were of significantly higher mean cellularity compared to 1 inch and 3 inch standard needles (p=0.003). Liver biopsies obtained with the short spinal needles had a higher mean cellularity but the difference was not statistically significant. When comparing the four needle types in all of the sampled tissues, the 3 inch spinal needle had significantly higher mean cellularity compared to the 3 inch standard needles (p=0.020), but differences in cellularity compared to the other needles were not statistically significant. The 1 inch spinal needles had higher mean cellularity than the 1 1/2 inch standard and long standard, but the differences were not statistically significant.

Conclusions: The results of this study support our hypothesis that 3 inch spinal needles provide more cellular samples of the liver as compared to standard needles. Suspected causes include increased exfoliation due to the shorter bevel and longer needle passes.
ECHOCARDIOGRAPHIC INDICES IN NORMAL BELGIAN MALINOIS AND GERMAN SHEPHERD MILITARY WORKING DOGS. David J. Fletcher, DVM, June Boon, MS, Kelly Mann, DVM, MS, W. Sherman Mathey, DVM, MS. James L. Voss Veterinary Teaching Hospital, Colorado State University, Fort Collins, CO 80523

INTRODUCTION:
Noninvasive evaluation of canine cardiac size and function is commonly performed by the use of cardiac ultrasound. Echocardiography allows accurate and timely assessment of congenital and acquired cardiac disorders and with continual improvements in ultrasound quality has become commonplace as a valuable routine diagnostic as well as prognostic tool. The determination of normal anatomical measurements and blood flow profiles is essential for accurate interpretation of the echocardiogram. Previous studies have established normal echo parameters for various breeds of dogs however to date no breed specific indices have been determined for the Belgian Malinois (BM) and German Shepherd (GS) dog. The objective of this study is to establish breed specific cardiac anatomical and blood flow measurements for the previously mentioned breeds of dogs.

MATERIALS AND METHODS:
Echocardiography was performed on 20 Belgian Malinois (5 intact male and 15 neutered female) and 20 German Shepherd (8 intact male, 4 neutered male, and 8 neutered female) dogs. Weights ranged from 44.5 to 79 lbs in the BM and 56 to 87 lbs. for the GS. Young healthy animals were used and ranged in ages from 18 to 41 months. Fifty-two dogs were screened via physical exam, thoracic radiographs, blood-work, and ECG prior to selection of the 40 animals for the study. Right and left short and long axis views were used during each study to obtain data. M-mode measurements were correlated with body surface area (BSA) and weight and statistically compared with predicted values based upon previously published data. Doppler derived measures of diastolic function, systolic function, and peak aortic, left ventricle, and pulmonary artery flow were measured.

RESULTS:
The mean, standard deviation, 95% confidence intervals, and range were calculated for each measurement. Comparison of M-mode mean values with predicted mean values after adjusting for BSA and weight revealed statistically significant differences between the means of several parameters. Results were similar for both breeds. Statistical significance was also noted in the Doppler derived indices between the observed means and previously published data as well as when mean values were compared between the BM and GS.

DISCUSSION:
In conclusion, we established breed specific echocardiographic indices for the Belgian Malinois and German Shepherd dog. Several cardiac indices were statistically different from previously published normal measurements suggesting the probable existence of breed specific differences relating to normal echocardiographic parameters.
ECHOENDOSCOPIC VERSUS TRANSABDOMINAL ULTRASOUND OF THE CANINE STOMACH: A CASE SERIES. L. Gaschen, PhD, D.V.M, Dr.med.vet., P. Kircher, Dr.med.vet., J. Lang, PD, Dr. med.vet. Dept. of Clinical Veterinary Medicine, Division of Radiology, University of Bern, Bern 3001, Switzerland.

Introduction: Ultrasound and endoscopy are currently the two most commonly used clinical tools for examination of the canine stomach. In humans, endoscopic ultrasound has been used for over 20 years where it has become a routine method of examining the stomach and contiguous organs. Echoendoscopy is preferred over transabdominal scanning since a high frequency transducer can be brought into close contact with the gastric wall to produce high resolution images. The purpose of this case series is to describe our first experiences with echoendoscopic examination of the stomach in nine dogs with vomiting and compare those findings with that of the transabdominal ultrasound findings and histological results of gastric mucosal biopsies.

Methods: Nine dogs with a history of vomiting (range four days to two years) underwent transabdominal ultrasound, echoendoscopy, gastroduodenoscopy and gastric mucosal biopsy, sequentially, within a two day period. Two-dimensional gray-scale and power Doppler ultrasound examination of the gastric wall was performed in all dogs. Transabdominal ultrasound examinations were performed in the conscious state with a multifrequency (5-10 MHz) curved array transducer and echoendoscopically under general anesthesia with a multifrequency (5-10MHz) Olympus video gastroendoscope. In addition, contrast-enhanced (SonoVue®, Bracco Suisse SA) power Doppler ultrasound of the gastric wall was performed in four of the dogs.

Results: Transabdominal ultrasound in seven dogs showed localized gastric wall thickening and two were diffuse. One dog with diffuse thickening was a false positive and the stomach wall was found to be normal echoendoscopically and histologically. Histology in the eight other dogs showed that 1 had a diffuse gastric wall edema, 1 an ulcer, and 6 had focal neoplastic disease. Gastric wall layering and the exact localization of lesions could be better assessed with echoendoscopy. The cardia, lesser curvature of the stomach and gastric antrum could all be better visualized with endoscopic versus transabdominal ultrasound. Obesity, large penetration depths, a deep-chested thoracic conformation and reverberation echoes due to luminal air were all found to be factors contributing to difficulty in the examination of the stomach wall transabdominally. With echoendoscopy, these factors played a much smaller role. Furthermore, power Doppler and contrast-enhanced power Doppler evaluation of the stomach wall were easier to perform echoendoscopically. Echoendoscopically-guided tissue sampling of the stomach wall was performed in one dog with a submucosal lesion that could not be identified with conventional endoscopy.

Conclusions: Endoscopic ultrasound allowed a more complete assessment of the stomach wall, its layering and draining lymph nodes as well as detection of increased mural vascularization in this series of nine dogs. Endosonographically, the stomach could be easily investigated from the cardia to the pylorus in all instances which was not the case for the transabdominal examination. In deep-chested, obese or large dogs, the transabdominal examination of the antral and pyloric regions as well as the cardia are the most difficult to perform. Endoscopic ultrasound made the Doppler examination of the gastric wall easier in all instances. In our experience, submucosal vessels can be identified even in normal dogs which is much more difficult with transabdominal scanning. Endoscopic ultrasound shows great

§ Aloka ProSound SSD-5500, Aloka Europa
¶ Olympus GF-UC140-AL5, Olympus Optical Co. (Europa), Hamburg, Germany
promise for the examination of the stomach in dogs and is very compatible with conventional endoscopy.
PANCREATIC DUCT DILATION IN CATS – A PROSPECTIVE AND RETROSPECTIVE STUDY

S Hecht, Dr. med. vet.1, DG Penninck, DVM1, OM Mahony2, MVB, R King1, DVM, S Pearson1, BA
From the Department of Clinical Sciences, Section of Radiology1 and Section of Medicine2, Tufts University School of Veterinary Medicine (TUSVM), North Grafton, MA 01536

Introduction/purpose
The ultrasonographic diagnosis of feline pancreatic diseases, especially pancreatitis, is difficult. Dilatation of the pancreatic duct has been described as an ultrasonographic feature in pancreatitis in a cat.1 In humans, gradual increase of pancreatic duct diameter can be observed with increasing age.2 Normal pancreatic duct width in cats aged 1 to 9 years was reported to range between 0.05 and 0.13 cm.3 The purpose of this study was to determine normal pancreatic duct width in healthy older cats and determine the significance of pancreatic duct dilation observed in a clinical population.

Materials and methods
In a prospective study, an ultrasonographic examination of the pancreas was performed in 15 healthy cats aged 10 to 20 years, and the maximum diameter of the pancreatic duct was determined. In a retrospective study, the ultrasound log of TUSVM was searched from 01/2000 to 06/2003 for cats which had been diagnosed with a dilated pancreatic duct. These patients were evaluated with respect to clinical, clinical pathologic and ultrasonographic findings and – if available – follow-up, cytology/histopathology, intraoperative findings or necropsy. The cats were divided into 4 groups according to the clinical and ultrasonographic suspicion for pancreatic disease (1 = pancreatic disease unlikely, 2 = suspected pancreatic disease, 3 = confirmed pancreatic disease, 4 = diabetes mellitus) and into 4 groups according to age (<1 – 5 years, 6 – 10 years, 11 – 15 years and > 15 years). Pancreatic thickness, location and width of a dilated pancreatic duct were recorded. Frequency and significance of pancreatic duct dilation with regard to age and clinical findings were examined.

Results
In the prospective part of the study, pancreatic duct diameter was calculated as 0.12 +/- 0.04 cm (range 0.06 – 0.24 cm) for the left limb, 0.11 +/- 0.03 cm (range 0.05 – 0.15 cm) for the body and 0.09 +/- 0.04 cm (range 0.06 – 0.16 cm) for the right limb. In 4/15 (26.7 %) healthy cats, the pancreatic duct measured wider than reference values published previously. Retrospectively, pancreatic duct dilation was diagnosed in 104/1445 (7.2 %) cats. In younger cats (<1 – 5 years), pancreatic duct dilation was observed in 2.7% of the cases, while 18.1 % of cats aged 15 years or older were affected. Forty-three cats (41.3 %) were categorized as group 1, 36 cats (34.6 %) as group 2, 9 cats (8.7 %) as group 3 and 16 cats (15.4 %) as group 4. In 41.3% of all cats, dilation of the pancreatic duct was considered to be most likely of no clinical significance.

Conclusion
A dilated pancreatic duct is commonly encountered in healthy older cats and is not necessarily an indicator of active pancreatic disease.

References
CROSS-SECTIONAL ANATOMY AND COMPARATIVE ULTRASONOGRAPHY OF THE EQUINE STIFLE JOINT  M. Hoegaerts. D.V.M., M. Nicaise, J.H. Saunders. D.V.M. Department of Medical Imaging, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium

Introduction: Injuries of the equine stifle are frequent causes of hind limb lameness. Ultrasonography (US) has been proved to be useful for the diagnosis of meniscal lesions, lesions of collateral, patellar, cruciate and meniscotibial ligaments and, the evaluation of the synovial structures, cartilage, subchondral bone and peri-articular remodelling. The US approach for the visualisation of the cranial and caudal parts of the menisci, the cruciate ligaments, the meniscofemoral ligament and the cranial meniscotibial ligaments has been described. However, a comparative study using gross anatomic sections to identify all structures visible on US images of the equine stifle has not been reported.

Purpose: The aim of this study was to provide a comprehensive comparative cross-sectional atlas of the normal equine stifle joint and its related structures using US.

Methods: Hind limbs of horses euthanatized for gastrointestinal disease were used. The animals had no history of orthopedic problems. Body weight ranged from 350 to 400 kg. A complete US examination of the stifle joint was performed using a systematic approach. The limbs were properly prepared by clipping the hair, washing the skin with hot water and the application of acoustic gel. The examination was performed with a linear 7-12 MHz matrix transducer (Logiq 7, GE Medical Systems) and/or a linear 6-9 MHz transducer and a convex 4-6 MHz transducer (Logiq 200, GE Medical Systems). The entire stifle was scanned in 2 perpendicular planes. Firstly, the medial femorotibial joint (MFT), the femoropatellar joint (FP) and the lateral femorotibial joint (LFT) were evaluated with the leg in extension. Then, the joint was flexed for the evaluation of the cranial part of the medial meniscus and, the cranial and caudal cruciate ligaments. Finally, the leg was re-extended for the evaluation of the caudal parts of the MFT, LFT and the caudal cruciate ligament.

The anatomical landmarks were exactly located US on each limb and labelled on the skin. The recesses of the MFT, the LFT and the FP were punctured under US guidance with a 18G needle and the synovial fluid was aspirated if present. Each compartment was filled with a pigment (technovit T 7143): the MFT with an orange, the FP with a red and the LFT with a yellow colour. The limbs were frozen for at least 48 hours at -18°C and each leg was cut in 10-15 mm thick slices using a motorised sawing-machine. Each leg was cut in a different plane corresponding to the scanning planes of the transducer during the US examination as described above. Each slice was defrosted, photographed using a digital camera (Cybershot DSC F707), and digitalised.

Results: From the collection of anatomic sections, representative images were selected. Instead of producing series of slices in 3 different planes, only sections comparable with the different US reference images were used. Bony and soft tissue structures were identified on these sections and subsequently located on the corresponding US images. The results of the study are shown in sequential matched photographs of the anatomical sections with their corresponding US images.

Discussion/Conclusions: US provided excellent anatomical detail of the stifle joint. The images of this study may serve as reference for clinical US imaging studies of the equine stifle joint.
DOPPLER ULTRASONOGRAPHIC EVALUATION OF GASTROINTESTINAL BLOOD FLOW IN DOGS WITH IBD AND FOOD HYPERSENSITIVITIES

P. Kircher1, J. Lang1, K. Allenspach2, F. Gaschen2, L. Gaschen1 Division of Clinical Radiology1 and Division Companion Animal Internal Medicine2, Department of Clinical Veterinary Medicine, Faculty of Veterinary Medicine, University of Berne, Switzerland

Purpose: Doppler ultrasound has been applied to the diagnosis of inflammatory bowel disease in humans. Chronic diarrhea is a common clinical problem in dogs, however, the etiology often remains unclear. Furthermore, IBD and food hypersensitivity are common components of the disease process in dogs. The goal of the study is to correlate Doppler findings with clinical disease activity and histology both pre- and post therapy in clinically affected dogs.

Material und Methods: 11 dogs with chronic diarrhea were included in this study after parasites and non-gastrointestinal causes of diarrhea were ruled out. Transabdominal ultrasound, endoscopy, intestinal biopsies and a colonoscopic antigen provocation (COLAP) test were carried out. Doppler waveform analysis of the celiac artery (CA) and the cranial mesenteric artery (CMA) was performed both in the fasted state and at 20, 40, 60 and 90 min after feeding the dog’s regular diet. The dogs were fed a restriction diet for 4 weeks and the ultrasound, endoscopic and COLAP examinations repeated. Resistive (RI) and pulsatility indices (PI) were calculated and compared statistically between dogs and between time points.

Results: The dogs were divided into two groups based on their response to therapy and change in clinical activity and were diagnosed with either IBD or food hypersensitivity. Group A (n=5) did not completely recover from disease; Group B; (n=6) was free of clinical signs. Group A (CMA: RI = 0.84 ± 0.03, PI = 2.72 ± 0.44; CA: 0.77 ± 0.04, PI = 2.04 ± 0.25) had fasted values significantly higher than group B (CMA: RI = 0.72 ± 0.04, PI = 1.77 ± 0.17; CA: 0.70 ± 0.04, PI = 1.66 ± 0.21). Prior to therapy, group A showed a suboptimal decrease in RI and PI values compared to normal dogs in a previous study.1 Group B showed no hemodynamic response during digestion. Post-therapy, fasting values normalized in Group B (CMA: RI = 0.80 ± 0.02, PI = 2.34 ± 0.15; CA: RI = 0.76 ± 0.06, PI = 1.97 ± 0.37) compared to pre-therapy measurements. However, an abnormal hemodynamic response was still present in both groups during digestion.

Conclusion: Fasting Doppler parameters of gastrointestinal vascular bed resistance in dogs with food hypersensitivity and IBD may correlate to the severity of disease and therapeutic outcome. We conclude that Doppler US investigations of gastrointestinal blood flow in dogs shows promise to quantify disease activity and to monitor therapy and a larger study population should be examined.

AN EVALUATION OF THE INTRA- AND INTER-OBSERVER VARIABILITY OF THE ULTRASOUND MEASUREMENT OF THE THYROID GLAND IN BEAGLE DOGS

Introduction: Ultrasonography (US) may represent an interesting tool in the diagnosis and follow-up of dogs with hypothyroidism. References values for measurement of the thyroid gland in some breeds predisposed to hypothyroidism have been published. However, the repeatability and accuracy of the US measurements have not been investigated.

Purpose: To evaluate the intra- and inter-observer variability for measurement of the thyroid gland in healthy beagles by use of US.

Methods: Three observers scanned independently both thyroid glands of five randomly presented euthyroid beagles, and this for three separate times. Each observer was asked to measure the maximum height, length and width of each thyroid gland. A linear transducer with a frequency of 12 MHz was used for this purpose (Logic 7, GE Medical Systems, Milwaukee, USA). The data were statistically evaluated and the volume of the gland was calculated using the formula of a rotation-ellips (volume = height x length x width x 0.479).

Results: The average measurement of the thyroid glands was: height = 0.5276 cm (std error = 0.05293), length = 2.4469 cm (std error = 0.08714), width = 0.6191 cm (std error = 0.02170), volume = 0.379 (std error = 0.04099).

The intra-observer variability was the lowest for the measurement of the height and volume and the highest for the measurement of the length. The inter-observer variability of the volume had the lowest variability.

Discussion/Conclusions: The measurement of the volume, using the rotation-ellips formula, appears the less variable parameter for the evaluation of the thyroid gland. The measurement of the height is more precise than that of the width and length. Further studies are necessary to define the accuracy of the measurements on normal dogs and hypothyroid dogs.

EFFECT OF PHENSTATIN PHOSPHATE ON TUMOR PERFUSION: EVALUATION IN A RAT MODEL USING MICROBUBBLE CONTRAST AGENT

Jodi Matheson DVM, Robert O'Brien DVM, MS, Dipl. ACVR, Ken Waller BS. University of Wisconsin-Madison, Madison, WI 53706

Introduction: Vasculature is critical to the survival, continued growth, and metastasis of tumors. New antineoplastic agents focus on preventing the growth of new vessels within the tumor as well as rapidly shutting down and destroying vessels already formed within the tumor. By evaluating tumor perfusion, the effects of the treatment can be monitored and adjusted for optimal effectiveness. Contrast harmonic ultrasonography has the potential to be an excellent modality to monitor tumor perfusion before, during, and after treatment.

The research was conducted in two phases. Phase I focused on establishing a tumor model to estimate perfusion using contrast harmonic ultrasound and to establish the optimal phenstatin phosphate (PP) dose for use in this rat tumor model. Phase II evaluated the effect of PP on tumor perfusion.

Methods: In phase I, eight 6-8 week old male Fisher 344 rats were inoculated subcutaneously with 1 x 10^5 9L glioma cells (ATCC, Manassas, Virginia) to produce 1cm tumors. Rats received a single intravenous injection (IV) of the antivascular drug, PP, at one of the following dosages: 20 mg/kg, 80 mg/kg, or 150 mg/kg. Each tumor was imaged prior to administration of PP, 1 hour, 4 hours, and 24 hours post-PP injection using a General Electric Logic 9 ultrasound machine equipped with a 7 MHz linear array transducer. Microbubble contrast agent (Sonovue™, Braaco Research SA, Geneva, Switzerland) was injected IV at a dose of 0.2 mls per injection. The tumor was imaged until peak contrast was seen and continued until the contrast dissipated.

In phase II, twelve Fisher 344 adult female rats were inoculated in the mammary fat pad with 1 x 10^5 MATBIII tumor cells (American Type Culture Collection in Rockville, MD) to produce 1 cm tumors. Six rats received a single IV injection of 150mg/kg of PP. Six rats received a similar volume IV injection of normal saline and served as controls. Imaging occurred 2 hours post-PP or post-saline injection. The tumors were imaged in the same manner as in Phase I except a 3.5 MHz linear array transducer was used.

All contrast harmonic cine loops collected were analyzed by determining the time of peak perfusion and a digital still image was captured. Percent tumor perfusion was assessed.

Results: Clinically, no adverse effects were seen at the highest PP dose of 150mg/ml. For phase I of the study the data were pooled regardless of PP dose as no significant differences were noted between percent tumor perfusion and dose of PP. At one-hour post-PP injection the percent tumor perfusion was significantly different (less perfused) from all other time points (P<0.05). There was no significant difference between any other time points. For phase II of the study, the PP treated group had significantly less percent tumor area perfused than the control group (P<0.0001). Tumor perfusion can be evaluated using contrast harmonic ultrasound.
ULTRASONOGRAPHIC EVALUATION OF THE CANINE EXTERNAL EAR CANAL, TYMPANIC MEMBRANE, AND TYMPANIC BULLA AFTER SALINE INFUSION INTO EAR CANAL OR TYMPANIC BULLA. K. Eom. DVM, PhD1, H. Lee. DVM1, Y. Sung. DVM1, H. Lee. DVM, PhD2, D. Chang. DVM, PhD3, J. Yoon. DVM, PhD4.

1College of Veterinary Medicine, Kyungpook National University, Daegu 702-701; 2College of Veterinary Medicine, Gyeongsang National University, Jinju 660-701; 3College of Veterinary Medicine, Chungbuk National University, Cheongju 361-763; and 4College of Veterinary Medicine, Seoul National University, Seoul 151-742, South Korea.

Introduction/Purpose: Ultrasonography has several advantages over traditional ionized imaging techniques for the evaluation of ear structure. However, the air and bone hamper ultrasonographic image quality. The method infusing the fluid into ear canal has been employed to overcome this pitfall and to facilitate more accurate imaging. Thus, the purpose of the present study is twofold: to describe the ultrasonographic appearance of ear canal; and to assess the relevance of non-invasive detection of the tympanic membrane intactness in live healthy beagle dogs and with otitis externa after introducing warm saline into ear canal.

Methods: Seven beagle dogs (five healthy dogs and two dogs with severe otitis externa), average 2 years old, weighing 8.5~10 kg were used. Hair of the region overlying the external ear canal and caudal and ventral part of the mandible was removed. The SONOACE 9900 PRIME® (Medison Co., Seoul, South Korea) equipment with an 11 MHz linear probe and a 6.5 MHz convex probe was used. In left-side five normal and three otitic ears, warm saline was infused into ear canal and massaged for thorough distribution. Ultrasonographic examination for the external ear canal and tympanic bulla was performed on transverse and longitudinal plane. In right-side five normal ears, the tympanic cavity was filled with warm saline by a 23G spinal needle bypassing the tympanic membrane under the guidance with video-otoscopy. And in left-side five normal ears, a complete tympanic membrane rupture was induced using an 18G needle under the guidance with video-otoscopy. Warm saline was infused into the ear canal and massaged. Ultrasonographic evaluations of the external ear canal and tympanic bulla were performed with same manner.

Results: Ultrasonographic examination using saline infusion into ear canal as an acoustic window was very useful to evaluate the internal structures of external ear canal, tympanic membrane, and tympanic bulla. The lumen of the ear canal was imaged as an anechoic structure and directed medially to the tympanic membrane, which was identified as a hyperechoic acoustically enhanced line. Although fluid filled tympanic bulla was easily visualized and assessed, it was almost impossible to identify whether the tympanic membrane was ruptured or not when tympanic bulla was also filled with fluid. An 11 MHz linear probe was more adequate for serial evaluation of the external ear canal, tympanic membrane, and tympanic bulla than a 6.5 MHz convex probe.

Discussion/Conclusions: The results of the present study suggest that ultrasonographic examination of the ear canal with 11 MHz linear probe after saline infusion into ear canal is useful to evaluate the ear canal and to detect the ear canal disease such as otitis externa, otitis media, and possible tympanic membrane rupture in dogs.
TRANSCUTANEOUS ULTRASONOGRAPHY OF THE ABDOMEN IN THE NORMAL COMMON MARMOSET (Callithrix jacchus). W.M. Wagner, BVSc(Hons), R.M. Kirberger. BVSc, MMEdVet(Rad). Diagnostic Imaging Section, Department of Companion Animal Clinical Studies, Onderstepoort Veterinary Academic Hospital, University of Pretoria, Private Bag X04, Onderstepoort, 0110, Republic of South Africa (wencke.wagner@up.ac.za)

Introduction: The common marmoset (Callithrix jacchus) is a popular pet in the Republic of South Africa and is a common patient of our Diagnostic Imaging Section. Two ultrasonographic reports1,2 could be found concerning the common marmoset or any other representative of the Callitrichidae, but to the best of the authors’ knowledge, there is no detailed publication on transcutaneous ultrasonography of the abdominal organs of the normal common marmoset.

Purpose: The object of this paper was to describe the normal echoanatomy of the abdomen of the common marmoset and to provide reference values for selected abdominal organs.

Materials and methods: Ultrasonographic abdominal examinations were performed on 17 clinically healthy, anesthetized adult common marmosets utilising a multi-frequency linear array transducer (5-9 MHz). The marmosets were 1.5 to 9 years old and weighed between 320 and 506 g. Since the marmosets formed part of an interactive study, hematology, biochemistry, abdominal ultrasound and skull radiographs were also performed and were normal. All ultrasonographic examinations were performed and evaluated by one author (WMW) and results entered on a custom-made form.

Results: There was good visualization of kidneys, bladder, spleen, adrenals, the liver and the gastrointestinal tract. Images of the spleen were difficult to acquire initially. The pancreas, caecum and abdominal lymphnodes were not seen. The spleen was the least echogenic organ, followed by the medium echogenic liver and the sometimes isoechoic, but mostly hyperechoic renal cortex. The kidneys had a poor corticomedullary distinction. The prominent right lobes of the liver extended caudally far beyond the costal arch. The gallbladder had a bi- to multilobed appearance with a wide, tortuous cystic duct. The pylorus was more centrally positioned. The adrenals were readily seen without a landmark approach. A statistically significant (p<=0.05) difference between female and male kidney, and right adrenal length was present. There was a significant correlation (p<=0.05) between body weight and splenic thickness. General limitations were the size of the common marmoset requiring a high frequency transducer with a small footpad. Reference values for the abdominal organs will be presented.

Discussion: Ultrasonographic examination is simple, fast, non-invasive, and easily repeatable in the common marmoset. This study emphasizes that significant species-specific differences exist in the echoanatomy of the abdomen. Simply applying canine or feline echoanatomy to the common marmoset will easily result in misdiagnosis such as chronic renal disease, hepatomegaly, obstructive disease of the biliary system and adrenal disease. Gender dimorphism existed concerning the size of the kidneys and needs further investigation.

References:

Introduction: Teleradiology, or the transfer of digital images for consultation or interpretation, is expanding in veterinary medicine. For small or remotely located practices it is a time- and cost-effective means of obtaining the opinion of a specialist. In a previous study, seven digital cameras varying in price and performance were tested for line pair and contrast resolution. In this study scanned images and digital images from the cameras were evaluated and compared to direct viewing of radiographs for detection of pulmonary nodules.

Materials and Methods: Two or 3 view thoracic radiographs were obtained from 44 dogs. 34 of these patients were diagnosed with pulmonary nodules and 10 were normal. Films ranged in size from 10 x 12 inches to 14 x 17 inches. For each camera, radiographs were illuminated using a horizontal light box, and the digital camera was positioned above the film using a tripod. The camera-film distance was adjusted so that the entire film was captured. Images were randomized and viewed (2 radiologists, 1 undergraduate student) using Adobe Photoshop 6.0. Eight of the cases were randomly chosen and duplicated twice to evaluate intra-observer variance. The observers independently recorded the number of nodules. The radiographs were randomized and evaluated independently (3 radiologists, 1 undergraduate student) for number of nodules. A consensus number of nodules was then determined by the group and used as the standard for comparison. Kappa values were determined individually and for the combination of the following: view, type (radiograph, scanner, cameras), and rater. A pair wise comparison between raters with adjustment for multiple comparisons was performed.

Results: For kappa values averaged over all views and all raters to compare detection of pulmonary nodules to the consensus detection of pulmonary nodules significant differences between the radiographs, scanner, and cameras were noted. Radiographs were significantly better than all other detection methods (P< 0.01). The scanner (Kodak LS75) was significantly better than the Kodak DC 4800 and the Sony DSC-707 (P< 0.05). The Nikon 995, Canon EOS-D30, and Ricoh i500 were significantly better than the Sony DSC-707 (P< 0.05). There was no statistically significant difference between the Kodak DC 3800, Kodak DC 4800, and the Sony DSC-707. For the pair wise comparison of raters (when evaluating the radiographs individually compared to the consensus), the raters matched the consensus rating from 85-92% with no significant difference between raters.

Conclusion: For detection of pulmonary nodules direct viewing of radiographs proved significantly better than evaluation of digital images. Significant variations exist between cameras.

SERVING IMAGES TO THE TEACHING HOSPITAL: A PILOT STUDY USING TABLET PC’S  D.D Barbee, D.V.M., M.S., T. Saveraid, D.V.M, J. Benczik, D.V.M., Ph.D. Washington State University, College of Veterinary Medicine, Department of Veterinary Clinical Sciences, Pullman, WA 99164-7060

Introduction: Institutional imaging departments welcome migration to ‘mostly’ or entirely digital imaging. The various client services in the teaching hospital may be less supportive due to the natural inertia toward change and real logistic problems in accessing images. This presentation discusses a pilot project using tablet PC’s and an inexpensive commercial DICOM viewing software approach.

Methods: A tablet PC\textsuperscript{a} was selected from various models available. The unit had 768 MB RAM, a 40 GB hard disk, 1 GHz processor and a standard operating system.\textsuperscript{b} Internet communication was by both an integral 802.11b (11 mbs) wireless and a 100 mbs Ethernet wired connector. The commercial DICOM viewer\textsuperscript{c} used by the Radiology section was installed. This computer was configured without a password, so that anyone could use it without logging on. The computer is stored on the docking and charging station in the Radiology reading room. Client services request the check-out of the tablet the same as scheduling a study. The request identifies the image set required and it is transferred to the tablet hard disk. Technologists from the various client services are trained to transfer their cases. Otherwise Radiology personnel perform this task. The tablet is usually checked out without an external charger, as the battery life is approximately 3 hours starting fully charged. For prolonged surgeries, the external charger can accompany the tablet providing unlimited on time.

Results: The faculty of our client services has developed applications for the tablet that were not envisioned by the Radiology section. While the use in the surgery rooms is very successful, faculty are often checking the tablet out for use in the examination and consultation rooms. They appreciate the ability to display animated studies such as fluoroscopy. The tablet can be passed to the client similar to a photographic print and this allows more natural communication postures as compared to facing a desktop or laptop computer. Intraoperative use has been well received. An assistant can position the tablet to the satisfaction of the surgeon. For involved image manipulations the tablet and stylus can be placed in a sterile plastic bag. The tablet is especially good at displaying complex, multi-image studies such as CT and MRI. The ability to track axial images on sagittal or coronal images simply cannot be duplicated on conventional illuminators. The tablet is often used in rounds, replacing a stack of film jackets.

Discussion: The acceptance has been as positive as it was unexpected. If the client services can be weaned from the laser hardcopies of digital studies, the film savings will pay for a tablet PC every 2 months. As wireless access spreads through the teaching hospital, the tablets may replace illuminators.

\textsuperscript{a} TC-1000, Compaq-HP, 3000 Hanover Street, Palo Alto, CA 94304-1185 USA
\textsuperscript{b} XP Personal Edition, Microsoft, Corporation, One Microsoft Way, Redmond, WA 98052-6399 USA
\textsuperscript{c} eFilm Workstation, Merge eFilm, 522 University Ave. 10th Floor, Toronto, ON, M5G 1W7 Canada
Introduction: Lung lobe torsion (LLT) is rare in dogs and cats, but can represent a life-threatening condition that warrants prompt diagnosis. The purpose of this study was to evaluate the radiographic features of LLT in a series of dogs and cats and attempt to identify unique features, or a combination of features, that may help differentiate LLT from other thoracic conditions.

Material and methods: A search for medical records and thoracic radiographs of dogs and cats with confirmed LLT was conducted at Tufts University School of Veterinary Medicine and at the Faculty of Veterinary Medicine of the University of Montreal over a period of 7 years. The signalment, clinical signs, hematology, pleural fluid cytology, histopathology and surgical reports were reviewed when available. Thoracic radiographs were evaluated for pleural effusion (amount and distribution), lung opacity (pattern and distribution), lung lobe position, lobar bronchi appearance (opacity, orientation and shape), position and shape of the trachea and the carina, as well as chronologic changes. Finally, ultrasonographic findings were reviewed when available.

Results: Medical records and radiographs of 11 dogs and 2 cats with confirmed LLT at surgery or necropsy were available for review. There was no breed, chest conformation or sex predilection identified for dogs, and their age median was 8.7 years (range 0.3 - 12 yr). The 2 cats affected were Domestic Short Hairs and were 10 and 14 years old, respectively. Clinical signs were variable, non specific and varied in chronicity. An elevated white blood cell count was noted in 7/13 patients. Pulmonary hemorrhagic infarction with or without fibrosis was identified histologically in 12/12 patients. A concurrent thoracic disease was found in 5/13 patients, including neoplasia in 2. The lobes affected were: right middle (6), left cranial (4), right cranial (2) and a combination of right cranial and middle (1). Extensive lobar bullous emphysema was observed on thoracic radiographs in 4 patients. A variable number of fragmented gas foci were seen in the affected lobe of 8 of the 9 other patients. This emphysematous pattern was progressive in 5/6 patients in which radiographs were successively obtained. A variable amount of pleural effusion was identified in all dogs and cats, which was asymmetrical in 9/13. Other common radiographic findings included medial displacement of a normal lung lobe by the twisted lobe extending along the chest wall (7), rotation of the carina (6), curved and displaced trachea (6), and a mediastinal shift (6). When it could be identified, the main bronchus of the affected lobe was displaced in 3 patients and focally narrowed in 5 patients. Ultrasonography was performed on 6 dogs and commonly revealed a uniform and poorly echogenic consolidated lung lobe that had central fragmented gas echos, no flow on color Doppler, and which was surrounded by pleural effusion.

Conclusion: Lung lobe torsion should be strongly suspected in dogs and cats when a pattern of lobar bullous emphysema is observed, especially if the lobe is displaced and surrounded by pleural effusion. Ultrasonography may be useful in some cases to rule out the presence of neoplasia and to confirm venous congestion or perfusion deficits.
SCATTER REMOVAL WITHOUT A SCATTER REMOVAL GRID

William J. Hornof

Scatter radiation appears as fog on the radiograph, and can result in severe image quality degradation, particularly in large patients with thick body parts. In screen/film radiography the contribution of scatter is so detrimental to image quality, that a scatter absorbing grid must be used to selectively absorb a portion of the unwanted scatter from the radiation reaching the detector. Unfortunately significant absorption of the primary beam also occurs when grids are used resulting in the need to increase patient and technician exposure by a factor of 3-4. The distribution of scatter reaching the detector is related to body thickness, composition, and beam energy. However, the distribution of scatter is difficult to model and attempts at digitally simulating and subtracting scatter have had limited success. We embarked upon a more simplistic approach by devising a geometrically simple phantom. The simple geometry permitted creation of a theoretical scatter free, primary beam image using minimal assumptions. The phantom was then radiographed both with and without a grid, with identical technique and positioning, using a 14 bit digital radiographic system. By subtracting the with-grid image from the non-grid image we created an image of the scatter and the primary beam that the grid had absorbed. The theoretical primary beam image was iteratively subtracted from that image until the phantom was no longer visible, resulting in an image of pure scatter. The pure scatter image was then iteratively subtracted from the original image until as close a match as possible to the theoretical primary beam image was obtained. The result of various frequency domain histogram equalization algorithms were then visually compared to the “primary beam” image. We conclude that in digital systems, scatter can be effectively removed without the use of grids, thus permitting a reduction in patient exposure.
SUBJECTIVE AND OBJECTIVE RADIOGRAPHIC ASSESSMENTS OF SAND ACCUMULATION IN THE EQUINE GASTROINTESTINAL TRACT.

Introduction/Purpose: Gastrointestinal sand accumulation is a common cause of equine colic. Subjective assessment of sand accumulation on abdominal radiographs has been used as a diagnostic aid; however, there is a poor correlation between clinical signs, diagnostic findings, and surgical findings. The purpose of this study was to define an objective method of assessment of radiographic sand accumulation in order to improve the diagnostic utility of radiography for sand colic.

Methods: Fifty-four sets of abdominal radiographs were reviewed from horses admitted to Michigan State University-Veterinary Teaching Hospital (1996 - 2003). These cases included 27 horses with a final diagnosis of sand colic and 27 horses with other diagnoses. Three observers independently graded these radiographs for amount of sand (score 0-5) and whether or not this sand was likely sufficient to cause colic (Y/N). The same radiographs were then re-examined with a more objective system, measuring amount of sand relative to the width and thickness of a rib (0-2), number of sand accumulations (0-3), sand opacity (0-2), sand homogeneity (0-2), and location of accumulation(s) (0-1). Summation of these scores provided a total value (0-12) for observed sand. Data analysis included inter-observer variance for each method and correlation of radiographic scores to final diagnoses.

Results: Inter-observer results using the subjective scoring method had significant differences among all observers. There was also poor subjective assessment as to whether or not the visible amount of sand was of enough quantity to cause colic. Using the objective method of sand assessment, there were no significant differences between the observers’ results. A score of 7 out of 12 was found to predict a positive diagnosis of colic with 80.7% precision.

Discussion/Conclusions: Current subjective radiographic assessment of gastrointestinal sand accumulation is highly variable and has a poor predictive value for disease. The designed objective scoring method creates a more uniform method to assess the sand accumulation. This method also provides the observer to quantify the amount of sand seen as this system uses a relative ordinal scale of 0-12. The objective scoring method has a high predictive value for colic if the obtained score is 7 or higher. To further validate this scoring system, this retrospective study is to be implemented in a prospective study to test whether this objective scoring system is sensitive to varying amounts of known gastrointestinal sand.
RADIOGRAPHIC INTERPRETATION OF THE EQUINE CENTRAL AND THIRD TARSAL BONES FOR DEVELOPMENTAL ORTHOPEDIC DISEASE

Introduction/Purpose
Developmental orthopedic disease (DOD) is seen in the central and third tarsal bones of the equine tarsus. Radiographic signs seen with a severe degree of DOD in the neonatal foal are easily identified as an abnormally developed central and/or third tarsal bone. A mild to moderate degree of DOD in these bones is a more difficult radiographic diagnosis. This presentation describes the normal radiographic measurements and appearance of the central and third tarsal bones and correlates this diagnostic information to recognizing the mild degree of DOD in these bones.

Methods
Radiographic examinations of the tarsi of 15 thoroughbred yearlings free of clinical signs were evaluated. The proximodistal dimension of the medial and lateral regions of the central and third tarsal bone was measured from the dorsoplantar (DPI), lateromedial (LM), and the dorso45°lateral-plantaromedial oblique (MO) radiographs. The radiographic appearance of each bone was evaluated for increased density in medial versus lateral aspect of each bone and the central versus the third tarsal bone. The presence of periarticular change at the dorsum of the distal intertarsal joint and periosteal productive change at the dorsum of the central and third tarsal bones was determined.

Results
The medial and lateral proximodistal measurements of the central and third tarsal bones from the DPI view were equal. The measurements of the medial proximodistal thickness of the central and third tarsal bones were equal as well as those for the lateral aspects of these bones. The trabecular pattern for the central and third tarsal bones was similar without evidence of increased subchondral density. Periarticular and periosteal remodeling on the dorsum of the central and third tarsal bones was not identified.

Discussion/Conclusions
The normal proximodistal measurements of both the central and third tarsal bones made from the DPI view revealed each bone is equal in thickness when comparing the medial to lateral aspects of a single bone. The results also revealed equal thickness when comparing the medial aspects of the central and third tarsal bones on the DPI, LM, and MO views. Periarticular and periosteal productive changes were not identified on the dorsum of these bones.

The radiographic findings of a proximodistal thickness difference between the medial and lateral aspects of either the central or third tarsal bones or between the medial aspects of the central and third tarsal bones is indicative of a developmental orthopedic disease. Increased density of the bone with the reduced proximodistal measurement is also indicative of DOD. Periarticular and periosteal remodeling commonly occurs in the involved bone(s).
LIMITED IMAGE QUALITY COMPARISON OF FILM SCREEN, DIRECT DIGITAL RADIOGRAPHY AND COMPUTED RADIOGRAPHY.  S.M. Puchalski DVM, W.J. Hornof DVM University of California, Davis, Davis, CA 95616

Introduction: Digital radiography is becoming increasingly more common in veterinary medicine, particularly in equine practice. Currently there are two basic types of digital radiography systems available in the veterinary market. Even though there have been a considerable number of investigations comparing these two systems in the literature frequented by physicists and engineers, there is a paucity of information available regarding even basic image quality evaluation of these systems in the veterinary literature. The purpose of this study was to simplistically compare three systems represented by a 400 speed film/screen combination, a computed radiography system (CR) and an indirect digital radiography system (DR). Each system was evaluated for speed, dynamic range, spatial resolution and contrast resolution.

Methods: Speed Comparison: LM radiographs of an equine cadaver carpus were made at a fixed FFD without a grid using the three different systems. All radiographs were made at 80 kVp with sequential variation of mAs. The resultant film radiographs were subjectively evaluated to determine an optimum technique. Both systems have a manufacturer recommended optimum range (numeric value) and the mAs required to produce a radiograph with a value at the mid point of this range was recorded.

Dynamic Range: Once an optimum mAs at 80 kVp was determined for each system, latero-medial radiographs were made a 0.25x, 0.5x, 1x, 2x, 4x and 8x of the optimum mAs and evaluated for diagnostic quality.

Spatial Resolution: Radiographs of a line pair phantom using a range of exposures were made. Comparisons were performed on all systems using radiographs made with 70 kVp and 1.0 mAs.

Contrast Resolution: Radiographs of a 20 well contrast phantom were made using a range of exposures. Comparisons were performed using radiographs made with 70 kVp and 1.0 mAs.

Results

<table>
<thead>
<tr>
<th>Dynamic Range</th>
<th>kVp</th>
<th>Range (mAs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Film / Screen (F/S)</td>
<td>80</td>
<td>0.64 – 2.5</td>
</tr>
<tr>
<td>CR</td>
<td>80</td>
<td>0.32 – 10.0</td>
</tr>
<tr>
<td>DR</td>
<td>80</td>
<td>0.32 – 10.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spatial Resolution</th>
<th>Line pairs / mm</th>
<th>Contrast Resolution</th>
<th>Visible Wells (20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/S</td>
<td>10 – 11.1</td>
<td>F/S</td>
<td>8-11</td>
</tr>
<tr>
<td>CR (8x10)</td>
<td>2.8 – 3.0</td>
<td>CR</td>
<td>20</td>
</tr>
<tr>
<td>DR (8x10)</td>
<td>5.6 - 6</td>
<td>DR</td>
<td>20</td>
</tr>
<tr>
<td>DR (13x16)</td>
<td>2.8 – 3.0</td>
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Discussion: Film screen was able to resolve far more line pairs than either of the digital systems, which were comparable. Both digital systems provided a much wider range of exposures resulting in a diagnostic radiograph than screen/film and a better ability to separate subject density differences than screen/film. The advantage of screen/film systems is their inherent resolution. An advantage of digital systems is their ability to compensate for exposure errors.
RADIOGRAPHIC ANATOMY OF THE THORAX AND ABDOMEN IN THE NORMAL COMMON MARMOSET (*Callithrix jacchus*). W.M. Wagner. BVSc (Hons), R.M. Kirberger. BVSc, MMedVet (Rad). Diagnostic Imaging Section, Department of Companion Animal Clinical Studies, Onderstepoort Veterinary Academic Hospital, University of Pretoria, Private Bag X04, Onderstepoort, 0110, Republic of South Africa (wencke.wagner@up.ac.za)

**Introduction:** The common marmoset (*Callithrix jacchus*) is a popular pet in the Republic of South Africa and is a common patient of our Diagnostic Imaging Section. Five articles could be found on radiography of Callitrichidae, but to the best of the researchers’ knowledge there are no publications on normal radiographic anatomy of the common marmoset or associated species.

**Purpose:** The object of this paper was to develop a standard radiographic procedure, and to provide a description and reference values for the radiographic anatomy of thoracic and abdominal organs in the normal common marmoset.

**Materials and methods:** Seventeen clinically healthy, anesthetized mature common marmosets (1.5 to 9 years) were examined radiographically. Since the marmosets formed part of an interactive study, hematology, biochemistry, abdominal ultrasound and skull radiographs were also performed and were normal. A selection of dorsoventral, ventrodorsal, right and left lateral recumbent whole body and collimated thoracic and abdominal radiographs were made at different respiration phases and centering points. All radiographs were evaluated by one author (WMW) and results entered on a custom-made form.

**Results:** Right-to-left lateral and ventrodorsal whole body radiographs made at end inspiration gave optimal results. The common marmoset had 7 cervical, 12/13 thoracic, 6/7 lumbar and 3 sacral vertebrae and 4/5 sternebrae. Images of the heart, lungs, liver, gastric axis, and at least one kidney could be evaluated consistently. A generalized interstitial/peribronchial pattern was normally present. The mean of the VHS on the ventrodorsal view was 9.34 (+/- 0.33) with a range of 9 to 9.7. Abdominal detail was mostly poor. The gastrointestinal structures could often only be identified due to their luminal gas. The pylorus was positioned in the midline. The right lobes of the liver extended caudally far beyond the costal arch. A statistically significant (p<=0.05) difference between female and male kidney length was observed. The spleen, pancreas, lymphnodes, bladder, and ureters were not seen in this study. Reference values for the remaining organs will be presented.

**Discussion:** Considering the often poor abdominal detail, the benefit of radiology as a diagnostic tool for abdominal pathology in the common marmoset may be limited. However, it should nevertheless provide useful information in a multitude of cases, such as foreign bodies, renal calculi, and dystrophic mineralization. Additional abdominal ultrasound examinations should be considered. Other diagnostic imaging techniques such as contrast studies of the gastrointestinal tract and urogenital system, and CT/MRI could also be considered, but baseline values have not yet been described. This study emphasizes that significant species-specific differences exist in the radiographic anatomy. Simply applying canine or feline radiographic interpretation principles to the common marmoset will result in misdiagnosis, such as bronchopneumonia, masses displacing the pylorus toward the midline, marked focal hepatomegaly, and ascitis. Gender dimorphism existed concerning the size of the kidney and needs further investigation.

**Acknowledgements:**

The authors thank the World Primate Sanctuary, and particularly Wendy McLeod, for supplying the marmosets for this study, the Exotic Animal Clinic for helping with the anesthesia, the radiology sisters of the Onderstepoort Veterinary Academic Hospital for technical assistance with radiographic procedures and recording of ultrasonographic measurements, and Kenneth Joubert for helping with the statistical analysis.
ACCURACY OF MYELOGRAPHY AT LOCALIZING THORACOLUMBAR INTERVERTEBRAL DISC PROLAPSE, USING POST-MYELOGRAPHIC COMPUTED TOMOGRAPHY AS THE GOLD STANDARD. P. M. Rist, DVM., J.P. Graham, MVB, M. S. Thompson, DVM., R. Clemmons, DVM, M. Blaik, DVM. University of Florida College of Veterinary Medicine, Gainesville, FL 32610

Introduction: The purpose of this study is to determine the accuracy of myelography for localizing intervertebral disc prolapse in comparison to post-myelographic computed tomography. Surgical findings have been used as the gold standard in previous studies. Surgical findings may be prone to error and bias, because the surgical approach is based on the myelographic interpretation. Post-myelographic CT is a superior gold-standard for determination of the site of intervertebral disc prolapse, and will provide a better estimate of the accuracy of myelography.

Methods/ Results: Twenty dogs presented to the UF-Veterinary Medical Teaching Hospital for suspected thoracolumbar disc prolapse were evaluated with standard myelography and post-myelographic computed tomography. Standard myelography included lateral, ventrodorsal, and both oblique views of the thoracolumbar spine. All myelograms were performed using a lumbar injection at L5-6 or L4-5. Iohexol (240mgI/ ml) was injected into the subarachnoid space at a dosage of 0.3ml/kg. Adequate filling of the subarachnoid space was determined using fluoroscopy or post-injection radiographs. After myelography, CT scans of the suspected lesion area were obtained. Transverse, 3 mm slices of the suspected site of prolapse, and at least one intervertebral disc space cranial and caudal to the suspected lesion site were obtained. The CT scans were performed using a Phillips Tomoscan-M 3rd generation helical scanner.

The radiographs from the myelographic exams were anonymized and evaluated by five independent reviewers (3 radiologists, 1 neurologist, and 1 radiology resident). Reviewers graded the quality of the myelograms and stated whether the exams were normal or abnormal. If abnormal, the reviewers were asked to state the predominant longitudinal and circumferential site of spinal cord compression, and quantify the confidence of the diagnoses.

The CT scans were interpreted independent of the myelograms at a computer workstation using e-Film® software. CT scans were determined to be normal or abnormal. A consensus localization of the lesion site was determined by the reviewers. The CT scans were used as the gold standard for determining the accuracy of the myelograms for ROC statistical evaluation.

Additional cases are currently being enrolled for data collection. Final statistical analysis will be presented.

Discussions/ Conclusions: Preliminary trends show that myelography may be less accurate than previously reported at localizing thoracolumbar intervertebral disc prolapses. The discrepancies between the results of this study and previous ones are most likely due to the use of post-myelographic CT as the gold standard, which appears more satisfactory.
EFFECTS OF BREATHING AND CARDIAC MOTION ON THE SPATIAL RESOLUTION IN MICROSCOPIC IMAGING TECHNIQUES OF RODENTS.

W. Mai, DVM, MS, DECVDI; C.T. Badea, PhD; C.T. Wheeler, BS, LAT; L.W. Hedlund, PhD; G.A. Johnson, PhD

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Introduction: High resolution imaging techniques have been developed over the past few years to provide researchers with non invasive tools allowing to study the huge number of rodent models of diseases. Some techniques like micro-computed tomography or magnetic resonance microscopy require the acquisition of very large datasets to reconstruct anatomic images. This necessitates to anesthetize the animals for *in vivo* studies, but also to develop strategies to limit the impact of cardiac and respiratory motions, and thus fully benefit from the very high resolution levels provided by the new technologies. These imaging techniques are now capable of producing very detailed pulmonary and cardio-vascular images in live rodents by synchronizing the image acquisition across multiple breaths and cardiac cycles. The precision with which one can control motion will probably define the resolution limit that can be attained in such studies. This work was performed to evaluate how reliably the respiratory and cardiac structures return to the same position from breath to breath, and heart beat to heart beat, each time data are acquired.

Methods: In one group of 10 anesthetized, mechanically ventilated rats, radio-opaque tungssten beads (0.28 mm diameter) were surgically glued on the abdominal surface diaphragm. Their range of motion (relative to a reference vertebral bead) was evaluated using a high-resolution (50 microns) digital radiography system. Images sets were acquired using two biological pulse sequences: (1) ventilation synchronous acquisition, and (2) both ventilation synchronous and cardiac gated acquisition. Series of 150-200 consecutive images were acquired and the distance between the diaphragmatic beads and the reference bead was calculated on each image using a semi-automated algorithm. In a second group of animals (n=3) beads were glued at the surface of the heart after thoracotomy, and the animals were allowed to recover for a few weeks. Then the animals were re-anesthetized and mechanically ventilated and the range of motion of the beads in reference to a static vertebral bead was also evaluated, using ventilation synchronous (end-expiration) and cardiac gated digital X-ray acquisition.

Results: Without any control of the motion, a displacement of up to 2 mm of the diaphragm can be expected over the ventilatory cycle. In the diaphragmatic motion studies, the standard deviation of the displacement was on the order of, or less than 100 microns. On non cardiac gated images, the bead on the dome of the diaphragm showed the highest range of motion due to the vicinity of the cardiac apex. Images acquired with cardiac gating in addition to the synchronization with the ventilation did not improve significantly the results. In the cardiac motion studies, the standard deviation of the displacement was on the order of 35 microns.

Discussion/Conclusion: This work provides the first quantitative measure of the motion imposed resolution limits for high resolution *in vivo* imaging of rodents. For the diaphragm, the standard deviation of the displacement was comparable to the resolution limit for *in vivo* magnetic resonance imaging imposed by signal to noise constraints. As methods for improving the sensitivity develop, methods to limit the impact of motion must follow. Cardiac gating in addition to synchronization to the ventilation does not improve significantly the results observed, due to the necessity of defining an acquisition window. For the heart, the standard deviation of the displacement was less than the actual resolution currently achievable for *in vivo* cardio-vascular MR imaging in rodents. As demonstrated here, with careful control of motion, its impact on resolution can be limited.
Introduction/Purpose: Radioimmunotherapy has been effective for the treatment of non-Hodgkin's lymphoma and may have similar efficacy for the treatment of canine lymphomas. Tumor pretargeting immunoscintigraphy and immunotherapy aim to minimize radiation exposure to normal tissue while maximizing delivery of a radiolabeled substance to a pretargeted lesion. A pretargeting protocol showing a high tumor to normal tissue ratio has been performed in a mouse model using synthetic oligomer, morpholino (MORF) conjugated anti-tumor antibody and radiolabeled complementary MORF (cMORF). Tumor pretargeting involves two separate steps. 1) Binding of antibodies with MORFs to tumor cells with subsequent clearance of non-bound antibodies from the body and 2) injection of radiolabeled cMORFs and subsequent binding to tumor cells due to the high affinity of oligomers, MORFs and cMORFs. The purpose of this study was to evaluate the clearance and biodistribution of radiolabeled morpholino oligomers and antibodies in 5 normal dogs.

Methods: 5 adult mixed breed dogs weighing between 22 to 30 pounds of body weight were used. All agents were administered through the left cephalic vein and blood was drawn from the contralateral leg vein to measure clearance. Following a 5-7 day interval dogs received: 5 ug (166.5 MBq) of 99mTc-labeled cytosine-free MAG3 - cMORF (5'- TAG TTG TGA AGT AGA AGA), (two dogs); 1 mg (107.3 MBq) of 99mTc-MAG3-non-specific IgG, (one dog); unlabeled non-specific IgG conjugated with MORF followed by 5 ug (166.5 MBq) of 99mTc-labeled cMORF 2 to 3 days later (three dogs). Static planar whole body images were taken immediate 1, 2, 3, 4, 5, and 24 hours after radiopharmaceutical administration. Nine blood samples (0.3ml) were drawn at specific time intervals and their activity measured using a well counter. ROI’s placed in all major organs were generated using dedicated postprocessing imaging software.

Results: Similar to the mouse model studies, clearance from circulation of 99mTc-cMORF was rapid with a t1/2 alpha of 4.8 min and t1/2 beta of 57 min (n=2) when administered alone with the kidneys as the target organ (0.83 % ID at 4 h) with minimal accumulation in other tissues. The gall bladder was evident after 1 h (0.6 % ID) and was visible throughout the imaging protocol. Following administration of the antibody-MORF, the labeled cMORF showed a rapid t1/2 alpha of 3.3 min (n=3) and an almost identical t1/2 beta of 56 min. There was a pronounced t1/2 gamma of about 20 h, most likely due to IgG remaining in circulation. The accumulation in kidneys was similar after antibody-MORF administration (1.54 % ID at 4 h). Liver and spleen showed 8% and 11% ID at 1 h and 4 h and 5% and 2.4% ID for 99mTc-cMORF alone which was lower than that of 99mTc-IgG alone (18% at both times). The 99mTc-IgG cleared with a 48 min t1/2 alpha and 33 h t1/2 beta.

Conclusion: Although the clearance and biodistribution of MORF conjugated IgG antibody and radiolabeled cMORF show some differences in the dog compared to the mouse model, the pharmacokinetics of both injectants are suitable to develop an effective radioimmunotherapy and tumor imaging protocol in dogs.
Introduction.- The accurate determination of the proximal extent of a primary bone tumor is important for limb spare procedures. There are publications comparing multiple imaging modalities, to try to determine which image modality is the best for the accurate determination of tumor extent of osteosarcoma (OSA) in long bones. Results from those publications are variable. Diethylene triaminopentaacetate adenosylcobalamin is a vitamin B-12 analog that has been labeled with 111Indium. Increased uptake has been seen in malignant tumors when compared with surrounding tissues. The purpose of this study was to compare radiography, planar bone scintigraphy using 99mTc - HDP and 111In – Vit B12 SPECT to determine the size of osteosarcoma in long bones in dogs.

Materials and methods.- This study was performed at the Colorado State University, VTH. Ten dogs were included in the study. Histopathology macroslides (gold standard) from the affected area, lateral views of the radiographs and planar scintigrams (99mTc – HDP) and sagittal plane image from 111In – Vit B12 SPECT scan were used to get the measurements. Region of interest analysis to obtain lesion to background ratio was used. Radiographic images were corrected for magnification. Statistical analysis included simple regression analysis, Spearman’s rank correlation for a non – parametric data, and correlation coefficient (R^2) adjusted for sample size. Statistical difference between R^2 was compared with F test. The statistical difference of radiopharmaceutical uptake ratio was tested with Paired T – test.

Results.- The mean percentage of tumor overestimation was 9.29% on radiographs, 5.35% on 99mTc planar bone scintigraphy and 33.25% on 111In Vit B12 SPECT scintigraphy. After separating the data into two groups, overestimated and underestimated tumor size, it could be seen that on radiographs tumor size was overestimated by a mean of 19.8 % in 70 % of the patients and underestimated in 30% of the cases. On planar bone scans tumor size was overestimated in 60% of the dogs by the mean of 13.6%, and underestimated in 40% of the cases. Tumor size was overestimated by the mean of 49.7% in 70% of the dogs on SPECT images and underestimated in 30% of the cases. There was positive linear relationship between variables studied. The correlation coefficient was significantly higher (P< 0.01) for 99mTc – HDP (75.5%) and radiography (61.3%) compared to 111In – Vit B12 (28.3%). Correlation coefficient for 99mTc - HDP was higher than the one obtained for radiograph but statistical difference could not be encountered (P<0.05). The mean ratio of radiopharmaceutical uptake obtained on 99mTc - HDP bone scan was significantly higher than 111In – Vit B12 SPECT (P< 0.01).

Discussion and conclusions.- The measurements obtained on 99mTc bone scans more accurately reflect measurements obtained on the macroslides and therefore it is better predictor of tumor size than radiograph and 111In – Vit B12. 99mTc bone scan is an acceptable good estimator of tumor size. There is no indication to use 111In Vit B12 SPECT to determine tumor size of OSA in dogs. MRI has been established as the best estimator in dogs (Wallack et al 2002). However, when technical and financial limitations related to the use of MRI are present, 99mTc bone scan should be considered as an appropriate technique to obtain the tumor extent of osteosarcoma in long bones.
ASSESSMENT OF VASCULARITY AND PERFUSION IN SPONTANEOUS CANINE TUMORS WITH CONTRAST-ENHANCED DOPPLER ULTRASOUND BEFORE AND DURING FRACTIONATED RADIATION THERAPY

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Introduction/Purpose: Vascularity and perfusion play a crucial role in tumor diagnosis and prognosis. Ultimately, they also influence the design of cancer treatment protocols. Recent experimental studies suggest that during radiation therapy both, tumor cells and endothelial cells of the microvasculature, are damaged by radiation. Therefore, the purpose of this study was to non-invasively investigate vascularity and perfusion in spontaneous canine tumors with contrast-enhanced color (CD) and power Doppler (PD) ultrasound (US) before and during fractionated radiation therapy (RT).

Methods: Tumors were sonographically examined during general anaesthesia with grayscale, CD and PD US before and after intravenous injection of an US contrast agent (Levovist®, Schering AG, Switzerland). With a computer program (Qwin®, Leica Microsystems AG, Switzerland), three parameters each were obtained for pre- and postcontrast CD and PD US. Fractional area (FA) represents a vascularity index and calculates the percentage area of the tumor occupied by blood vessels. Mean color level (MCL) and color-weighted fractional area (CWFA) assess perfusion. Tumors were localized in the oral cavity, on the skull or on extremities. Pre-radiation US was performed in 60 tumors: 35 soft tissue sarcoma, 7 bone sarcoma, 7 squamous cell carcinoma, 5 oral melanoma, 3 acanthomatous epulis and 3 miscellaneous tumors. Forty-four dogs underwent either palliative (31 animals) or curative (13 dogs) fractionated RT. In the palliative group (4x6 Gy, 5x6 Gy or 3x8 Gy), US was done before each fraction, while in the curative group (14-16x3.5 Gy or 15x3 Gy) animals underwent US before fraction 1, 3, 6, 8, 10, 12, 14 and 16.

Results: Before RT, vascularity and perfusion were high in squamous cell carcinoma, whereas all sarcomas and the miscellaneous tumors were poorly vascularized and perfused. In the oral melanoma and acanthomatous epulis group, vascularity and perfusion were moderate. A significantly higher vascularity and perfusion was observed in small tumors compared to large tumors. During the course of RT, vascularity and perfusion did neither change significantly in the palliative nor in the curative group. Significant changes were also not observed in soft tissue and bone sarcomas; vascularity and perfusion stayed poor during RT. Other tumor histology groups were too small in numbers to be analysed during RT.

Discussion/Conclusions: Vascularity and perfusion appear to significantly depend on tumor size and histology groups. During the course of RT, no change in vascularity and perfusion was observed in sarcomas. Other tumor histology groups will be investigated in the near future for comparison. In order to gain more meaningful information on tumor vascularity and perfusion, especially during various treatment procedures, spontaneous canine tumors may serve as a useful model.
EPIDERMAL GROWTH FACTOR RECEPTOR EXPRESSION IN CANINE ORAL CAVITY SQUAMOUS CELL CARCINOMA

Introduction: Overexpression of the epidermal growth factor receptor (EGFR) has been demonstrated in most human epithelial neoplasms. Excessive EGFR-mediated signaling culminates in loss of cell cycle control, inhibition of apoptosis, and stimulation of angiogenesis. Such overexpression of EGFR has been correlated with a resistance to chemotherapy and radiotherapy and, hence, a poor prognosis. The role of EGFR aberrance in the development and progression of neoplastic disease supports the notion that the EGFR is a relevant target for cancer therapy. Currently, little information is known regarding the role of EGFR in companion animal epithelial neoplasms. Definitive therapy using surgery and radiation therapy can provide long term disease control for many dogs with oral cavity squamous cell carcinoma (SCC), particularly those patients with small, rostrally-located tumors. However, tumor size and location hinders long term disease control for many patients with oral SCC. Anti-EGFR therapy may enhance the efficacy of definitive therapy for these patients. The purpose of this study is to determine the level of EGFR expression in naturally occurring canine oral cavity squamous cell carcinoma.

Methods: Twenty-nine formalin fixed, paraffin embedded biopsy samples from canine oral cavity squamous cell carcinomas were analyzed for EGFR expression using immunohistochemical evaluation. Specimens were collected from untreated clinical patients during the period of 1996-2003. Tissue sections were deparaffinized, rehydrated, and prepared with peroxide, PBS and blocking serum. Monoclonal mouse anti-human EGFR antibody was used as the primary antibody. A biotin-avidin peroxidase secondary antibody system was used for immunoreactive complex detection. DAB chromogen was used to visualize immune complexes. EGFR staining intensity and distribution was evaluated using light microscopy. Normal oral mucosa and various known EGFR-postive and EGFR-negative tissues were used as controls.

Results/Discussion: Analysis of results is currently ongoing. Identification of EGFR overexpression may not only yield prognostic information but may also provide the rationale for the investigation of targeted anti-EGFR therapy for dogs with oral cavity squamous cell carcinoma.
PREVALENCE OF ANEMIA IN FELINE PATIENTS UNDERGOING CURATIVE INTENT RADIATION THERAPY.

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\textbf{Introduction:} Anemia is important in the feline radiation therapy patient because it may lead to tumor hypoxia thereby reducing the effectiveness of radiation therapy. In addition, these patients undergo multiple episodes of anesthesia during the course of their treatment and anemia may increase their anesthetic risk. Moreover, in people anemia has been associated with fatigue which leads to a decrease in quality of life.

The purpose of this study was to determine the prevalence of anemia before and during radiation therapy, and to identify potential risk factors for anemia in feline cancer patients treated with radiation therapy at Colorado State University (CSU).

\textbf{Methods:} The medical and radiation records of 110 cats treated with curative intent radiation therapy at CSU between 1994 and 2004 were reviewed. Signalment, tumor type, radiation dose, fraction number, field size, anesthetic protocol, and blood parameters (including packed cell volume) at the beginning and during the course of treatment, were obtained.

\textbf{Results:} There were 110 cats in the study consisting of 60 castrated males, 1 intact male, and 49 spayed females, with a median age of 10 years [range 2-19], and median weight of 4.8 kg [range 2.5-10.5]. Tumor histological classifications included 79 soft tissue sarcomas, 14 carcinomas, 6 lymphomas, 2 mast cell tumors, 3 meningiomas, 5 pituitary tumors, and 1 osteosarcoma. Tumor locations included 35 head, 16 lumbar, 2 limb, and 57 thorax. Median field length was 18.5 cm [range 4-35], median fraction number was 19 [range 10-31], and median radiation dose was 57 Gy [range 33-69.75]. At the start of radiation therapy 23 cats were anemic and during radiation therapy 55 additional cats became anemic.

\textbf{Conclusion:} Twenty one percent of cats were anemic at the beginning of radiation therapy, and 63% of the remaining cats became anemic during treatment. Hence, 78 cats (71 \%) were anemic at some point during their radiation therapy. Factors involving the patient (sex, age, and weight), tumor (type and location), and treatment (anesthetic regimen, field length, fraction number, and total dose) were investigated for association with anemia. Identifying the associated risk factors for anemia may help abate the incidence of anemia in cats undergoing radiation therapy.
Introduction: Over the years, a wide variety of materials have been used as “tissue equivalent” bolus for radiotherapy purposes (RF Moyer et al, 1983). A potential benefit of using a bolus is to have maximum radiation dose occur at the surface or at reduced depth within the irradiated tissue (GC Bentel, 1996). In veterinary radiotherapy, the commercial bolus Superflab (GR Feaster) and the homemade boluses of Play-Doh (Hasbro, Inc) and of water-soaked cotton gauze sponges are among the materials that have been utilized. However, documentation of the validity of utilizing either Play-Doh or water-soaked gauze sponges as bolus material was not found.

Purpose: This study was performed to determine if carefully made boluses of either Play-Doh or water-soaked gauze sponges differed from the commercial bolus material, Superflab, in producing maximum radiation dose when irradiated with a cobalt-60 teletherapy source.

Method: One bolus of Superflab, 5 boluses of Play-Doh, and 5 boluses of water-soaked gauze sponges were irradiated with cobalt-60. The radiation doses were measured with thermoluminescent dosimeters (TLD’s) calibrated to be accurate for cobalt-60 photon energies at doses less than 10.0 centigray. Six TLD’s were utilized to measure each irradiation. The 1 Superflab bolus was irradiated 5 separate times; each of the 5 boluses of Play-Doh and the 5 boluses of water-soaked gauze sponges were irradiated 1 time. Thus, there were a total of 30 TLD readings from 5 separate irradiations of each of the 3 types of bolus material.

Results: The resulting radiation doses were similar when utilizing the Play-Doh, the water-soaked sponges, or the Superflab. Statistically, there were no significant differences in dose results obtained from irradiating these 3 types of bolus material. Doses resulting from the Play-Doh boluses more consistently approximated those of the Superflab. Some experiment effects were detected, i.e. variation in results occurred both within each type of bolus material and among types of bolus material.

Conclusion: The results of this study indicate that either Play-Doh or water-soaked cotton gauze sponges can suffice as material for carefully made bolus for cobalt-60 teletherapy. However, the failure to detect a statistically significant difference between these materials is not statistical proof of their equivalence.
ASSESSMENT OF PERFUSION AND HYPOXIA IN SPONTANEOUS CANINE TUMORS USING POSITRON EMISSION TOMOGRAPHY

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Introduction/Purpose: Tumor hypoxia plays an important role in cancer treatment in general, and in radiation therapy in particular. Hypoxic tumors behave biologically more aggressive and it has been shown in several clinical studies that the prognosis for hypoxic tumors is significantly worse compared to normoxic tumors. The current gold standard for measurement of tumor hypoxia is an invasive needle technique using a polarographic system. The purpose of this study was to validate the potential of a new hypoxia tracer, 18F-EF5 to determine hypoxia in spontaneous canine tumors. Further, we wanted to assess the relationship between tumor hypoxia and tumor perfusion using a continuous injection of 15O-H2O.

Methods: PET studies were performed in 11 dogs with various spontaneous tumors (8 sarcomas, 2 carcinomas, 1 epulis). In 7 dogs double-tracer studies could be acquired. The animals were imaged in a whole body PET scanner using a dynamic protocol (Advance, GE Medical Systems). At different time points urine and arterial blood samples were collected from these dogs to determine by High Performance Liquid Chromatography (HPLC) how 18F-EF5 was metabolized and how long activity was present in the plasma-circulation. Five of 11 dogs had invasive pO2 measurements with the Eppendorf apparatus.

Results: Tumor hypoxia could be detected in 5 of 11 dogs. 18F-EF5 accumulation occurred primarily in low perfused tumors. In the HPLC analysis no 18F-EF5 metabolites were observed in urine or plasma for a period of 150 min after injection. In 3 of the 5 tumors both techniques, PET and Eppendorf revealed tumor hypoxia. In one tumor, hypoxia was detected with PET but not with the Eppendorf measurement. In one tumor neither with PET nor with the invasive technique could hypoxia be detected.

Discussion/Conclusions: The PET tracer 18F-EF5 proofed to be of value for tumor hypoxia detection. Although only a small group of animals could be studied, a correlation was seen in 3 of 4 animals which had hypoxia detected with invasive methods. However, currently the yield of the synthesis of 18F-EF5 is too low, with a maximum of 280 MBq ever produced at once. For a human patient a dose of at least 370 MBq is needed. Therefore, improvements in the production of the PET tracer have to be done before routine use.
RADIOSENSITIVITY OF CANINE MELANOMA CELL LINES
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Introduction/purpose: Oral melanoma in the dog is a highly aggressive malignant tumor. Combinations of surgery and radiation therapy are often used to try to obtain local control of this disease. It is thought that melanomas are resistant to radiation and that the resistance may be overcome by use of large dose per fraction. Reported protocols include treating melanomas at 4, 6 or 8Gy per fraction. Despite these efforts, local recurrence rates of up to 30% are reported. The purpose of this study was to evaluate canine melanoma cell lines with regard to their radiosensitivity and to compare the variation of radiosensitivity between cell lines. Additionally, the study evaluated the effect of dose per fraction on cell survival.

Methods: Four cell lines were established from biopsies taken from clinical patients diagnosed with oral melanoma. Cells were passed through 20 passages and were then confirmed to be melanomas by immunohistochemistry using a panel of antibodies that included Microphthalmia transcription factor, S100a, Melanoma Ab-1 (gp100) and MelanA. A clonogenic assay was used to determine the intrinsic cell radiosensitivity (2—15Gy). SF2, SF4 and linear quadratic parameters were determined to analyze survival differences.

Results: The median SF2 and SF4 was 0.23 (mean 0.23; range 0.22-0.24 and 0.20 (mean 0.20; range 0.13-0.26) respectively. No significant difference was found between cells lines at 2Gy and 4Gy. A strong dose response relationship was found in two (2/4) cell lines. In those two cell lines, a 2Gy dose increase resulted in a significant increase in cell kill at all dose levels. In the other two cell lines, a dose response threshold reflecting a large shoulder was found. A significant dose response was found only at doses greater than 8Gy. A correlation between these findings and the α/β ratios was found.

Discussion/Conclusions: All of the cell lines tested were radioresistant. Although preliminary, these findings suggest that melanomas differ in their response to changes in dose per fraction. In two of the cell lines, radioresistance was overcome only with doses larger than traditionally used in palliative radiotherapy. For the other two cell lines, radioresistance was overcome with doses as low as 4Gy. The variation in response of the cell lines to irradiation may help explain the heterogeneity of response of oral melanoma to hypofractionated radiotherapy.

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A STANDARDIZED PROTOCOL FOR THE ULTRASOUND EXAMINATION OF THE EQUINE STIFLE  M. Hoegaerts. D.V.M., J.H. Saunders. D.V.M. Department of Medical Imaging, Faculty of Veterinary Medicine, Ghent University, Salisburyaan 133, 9820 Merelbeke, Belgium

Introduction: Injuries of the equine stifle are frequent causes of hind limb lameness. Ultrasonography (US) has been proved to be useful for the diagnosis of stifle injuries.

Purpose: The aim of this study was to establish a protocol for the standardised and systematic US examination of the equine stifle and to evaluate its usefulness in horses suspected of stifle joint disease.

Methods: Nine hind limbs of horses that were euthanatized for gastrointestinal disease were used. The limbs were properly prepared. The examinations were performed with a linear 6-9 MHz transducer, a convex 4-6 MHz transducer (Logiq 200 pro, GE Medical Systems) and a linear 7-12 MHz matrix transducer (Logiq 7, GE Medical Systems).

A protocol was established in five steps (a “five-step-tour”) for a complete systematic US examination of the equine stifle based on the anatomy of this joint (3 compartments, large caudal muscular mass) and the position of the leg (weight bearing or flexed). Firstly, the medial femorotibial joint (MFT) (step I), the femoropatellar joint (FP) (step II) and the lateral femorotibial joint (LFT) (step III) were evaluated with the leg weight bearing. Secondly, the joint was flexed 90° for the evaluation of the femoral condyles, the cranial meniscotibial ligaments (MTL), the tibial attachment of the cranial cruciate ligament (CrXL) and the femoral attachment of the caudal cruciate ligament (CdXL) (step IV). Thirdly, the leg was weight bearing for the evaluation of the caudal parts of the MFT, LFT and the tibial attachment of the CdXL (step V).

The “five-step-tour” was applied to 20 horses suspected of stifle pathology. Five horses had a meniscal tear, collapse or mineralization of the MM; 1 horse had a caudal prolapse of the MM; 2 horses had a desmitis of the MCL or LCL; 5 horses had osteochondrosis of the lateral and/or medial femoral ridge; 13 horses had a synovitis of the MFT, LFT and/or FP and, 4 horses had patellar ligament desmitis.

Results: The more consistent features were an easier and better visualisation of the MM compared to the LM and a lesser organized proximal attachment of the MCL compared to the LCL. The visualisation of the LM was consistently better with the convex transducer.

On the 20 living horses, steps I to III allowed an appropriate visualization of all the anticipated structures. The approach with the leg in flexion (step IV) was difficult because the flexion was only well-tolerated during 3 to 5 minutes. The visualisation of the cranial part of the LM and the lateral MTL was not always consistent because these structures are covered by the tendon of the extensor digitorum longus muscle. The tibial attachment of the CrXL was always anechoic because the fibres could not be orientated perpendicular to the US beam. On step V, the visualisation of the femoral condyles and the caudal parts of both menisci depended on the thickness of the thigh. Due to the topographical anatomic orientation, the tibial attachment of the CdXL was difficult to visualize and the MFL was impossible to see.

Discussion/Conclusions: The evaluation of the structures of the stifle joint may be overwhelming for a moderately-trained practitioner. Initially, practitioners may choose to perform routinely steps I (MFT), II (FP) and III (LFT) of the protocol. When comfortable with these, structures of steps IV and V of the protocol can be added to the examination. However, even with an appropriate training, some structures such as the CdXL, can not always be correctly visualized.
Introduction: Ununited medial epicondyle (UME) is reported as uncommon, poorly defined and is not well documented.\textsuperscript{1,2} UME is more common in Labradors, and is thought to often be bilateral.\textsuperscript{1} Radiography is the primary diagnostic method and UME may only be visualized on the craniocaudal (CC) view.\textsuperscript{1} Currently, elbow evaluation by the Orthopedic Foundation for Animals (OFA) only requires a flexed lateral view. Few cases are reported with radiographic progression in size or recurrence of fragments following excision.\textsuperscript{1,2}

Materials & Methods: Same-sex littermates of 48 Labrador retrievers from 7 litters were paired. One of each pair was free-fed (control group). The restricted group was fed 75% the calories of the control group. Elbows of all dogs were radiographed during 6, 8, 10 and 12 years of age, and at end-of-life.

Results: Seven (15\%) were diagnosed by radiography from 5 litters. Right elbows (n=5) were more affected than left (n=3). The control group (n=4) and restricted group (n=3) were almost equally represented. Females (n=5) were affected more than males (n=2). Six (86\%) had unilateral lesions. One was bilaterally affected and ultimately euthanized due to lameness. UME was evident on CC views by 6 years in 6 dogs; a bilaterally affected dog was confirmed at 8 years. In only one elbow, UME was detected on the lateral view; in all others it was not diagnosed using this view through end-of-life. UME fragments of 1 dog grew in size. Two dogs had elbow osteoarthritis.

Discussion/Conclusion: UME may be more common than thought. Most cases were unilateral and diet restriction had no effect on onset, although small population size makes significance difficult to determine. Most cases lacked elbow osteoarthritis or fragment growth. The CC view was critical for accurate diagnosis. The presumed infrequent diagnosis could be attributed to the singular flexed lateral view as required by the OFA. Two views are critical for elbow dysplasia screening and radiographic evaluation should be continued for life particularly in breeding dogs.


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VALIDATION OF A 40 MHZ B-SCAN ULTRASOUND BACKSCATTER MICROSCOPE FOR THE EVALUATION OF OSTEOARTHRITIS LESIONS IN AN ANIMAL MODEL.
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Introduction/Purpose: An improved understanding of osteoarthritis (OA) pathophysiology has now opened a landscape for new therapeutic targets and drug discovery. Currently much research is aimed at validating drugs which may modify disease in OA. Validation of these drugs would require tools able to diagnose osteoarthritis early and to follow its evolution in a cost effective manner. Radiography identifies the later stage disease diagnosis and does not image articular cartilage. MRI and ultrasonography can image soft tissues but, presently, clinically available systems lack adequate resolution to image early OA lesions. Very high frequency ultrasound systems with 40 to 60 MHz transducers have been designed and attain a resolution on the order of 50 μm. They have found application in ophthalmology, dermatology and intravascular fields. Their capacity to image articular cartilage has been reported but they have never been validated in a surgical model of osteoarthritis commonly used for OA drug efficacy studies. We hypothesised that this system should accurately detect many histological lesions of OA. The objective of this study was to evaluate a 40 MHz B-scan ultrasound backscatter microscope for the detection of OA lesions of varying severity in an animal model of osteoarthritis.

Methods: Thirty five adult New Zealand White rabbits were used in this study. Unilateral transection of the anterior cruciate ligament was performed under aseptic conditions on twenty four rabbits which were euthanized at 4, 8 and 12 weeks post surgery and eleven rabbits were used as controls. Ultrasound backscatter microscopy was performed on the femoral articular surface following dissection of the knee joint. The articular cartilage was examined and graded macroscopically using India Ink and histologically for OA lesions. Histological examination was used as a reference to determine the sensitivity and specificity of ultrasonographic and macroscopic examination for identification of fibrillation and ulceration of articular cartilage.

Results: The sensitivity and specificity of ultrasound backscatter microscopy were respectively 92.3% and 96.4% respectively to detect histological fibrillation and 90.9% and 97.6% to identify histological ulceration. By comparison macroscopic examination using India Ink had a sensitivity and specificity of 80.0% and 96.4% respectively for fibrillation and 90.9% and 90.5% for ulceration when compared to histology. Identification of slight surface irregularities was made possible with ultrasonography. An excellent correlation was found between ultrasonographic and histological scores (r₁₀ = 0.90).

Discussion/Conclusions: B-scan ultrasound backscatter microscopy is a valuable tool for the evaluation of OA lesions as it allows an accurate evaluation of the cartilage surface with easy detection of fibrillation, a hallmark of the early stage of osteoarthritis, it also offers an evaluation of the internal structure of cartilage without the need for biopsy. Coupling this system to needle or standard arthroscopic instrumentation for articular cartilage assessment in osteoarthritic patients or animal models may permit early diagnosis of osteoarthritis and evaluation on the evolution of the disease or the response to therapeutic intervention in longitudinal studies.

Introduction: The purpose of the study was to develop a method to semi-automatically measure cardiac parameters from M-Mode ultrasonographic images. This would allow measurements to be made after the images were made and stored. Parameters measured included the left ventricular diameter and fractional shortening. A snake [1] algorithm was used to segment the objects of interest. Snakes or active contours are energy minimizing functions that are initialized close to the edge of structures in the image. Snakes are made to conform to the image edges using finite difference methods. Measurements made using the snake method were compared with the measurements made by two radiologists. Early results are encouraging.

Methods: The initial phase of the study was the testing of the snake algorithm on phantom images. Next, M-Mode images were selected from echocardiograms that had minimal noise. For automatic measurements, one of the investigators (K.K.), using a mouse, clicked the points on the image close to the edge of the interventricular septum to initialize the contour. The algorithm fit a curve through the selected points. The procedure was repeated for the edge of the left ventricular free wall (LVFW). Numerical methods were used to conform these initial contours to the interventricular septum (IVS) and the LVFW allowing generation of values for the left ventricular diameter and fractional shortening. Values obtained in this manner were compared to values obtained by one of two radiologists (M.H., J.A.H.) from the same echocardiograms using calipers on the ultrasound machine. A paired t-test was used to determine if there was any significant difference between measurements made semi-automatically and those made by radiologists. In preliminary work, each parameter was measured once for each echocardiogram. Additional images are being evaluated with each parameter being measured three times.

Results: Table one shows preliminary results comparing automatic measurement to one set of values obtained at the time of echocardiography. Early results show less statistical difference between the two types of measurement for diastolic values (p=0.5430) than for systolic values (p=0.05375). Evaluation of additional data is in progress and results will be described.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Radiologist</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVD (D)</td>
<td>LVD (S)</td>
</tr>
<tr>
<td>3.153</td>
<td>1.5467</td>
</tr>
<tr>
<td>2.9506</td>
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<td>1.4483</td>
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<tr>
<td>5.0618</td>
<td>2.6616</td>
</tr>
</tbody>
</table>

LVD= Left ventricular diameter; D=Diastole; S=Systole
Measurements are in centimeters.