SIMULTANEOUS 18F-FDG POSITRON EMISSION TOMOGRAPHY AND COMPUTED TOMOGRAPHY FOR EVALUATION OF CANINE LAMENESS: PRELIMINARY EXPERIENCE AND FUTURE OPPORTUNITIES

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INTRODUCTION

BACKGROUND

• FDG is a glucose analog
  • Best known for use in oncology
  • Normal/abnormal physiology of glucose metabolism in injury, infection or muscle activity

• Fused PET-CT or PET-MRI is better than using any modality alone
  • Fusion of anatomical and functional data

• Integrative Neurophysiology Lab
  • Thorsten Rudroff
INTRODUCTION

HYPOTHESIS & AIMS

• Prospective, descriptive case series
  • 25 clinically lame dogs

• Objective morphological lesion localization and quantifiable functional measurement of glucose metabolism
  • Increased muscle use
  • Tissue inflammation, infection or injury
METHODS

Patient Selection

- Naturally-occurring diseases
- Clinical Research Review Board
- Criteria

  - Referred lameness or presumptive diagnosis of musculoskeletal injury
  - Scheduled for a clinically indicated CT
  - Informed consent for whole body 18F-FDG PET-CT examination

Clinical Examination

- Medical history; physical, orthopedic and neurological examination; and, gait exam

  - Determine the affected anatomical region and degree of lameness

  - Additional imaging studies were performed by radiologists

  - Clinical relevance determined by the patient's primary clinicians
METHODS

PET-CT IMAGING PROTOCOL

• Leash-walk for 15 minutes
• Premed and induce anesthesia
• Positioned in dorsal recumbency
  • Padded troughs, wedges and tape
• Positional, anatomical symmetry
  • Forelimbs moderately extended
  • Hindlimbs fully extended

IMAGE ANALYSIS

• One investigator, blinded to clinical results and subsequent therapies
• Qualitative normal/abnormal uptake
  • Radionuclide uptake greater than normal activity in blood or contralateral anatomy
• Quantitative analysis of FDG uptake
  • Standardized uptake value (SUV) within the area of increased radionuclide activity (IRU)
• Concurrent CT abnormalities

NEOPLASIA
Discospondylitis at C2-3, T8-9, L1-2 and sternum.
IRU, Lysis and Sclerosis at Origin of Right Cranial Cruciate Ligament.
Sacroiliac joint inflammation / osteomyelitis (right and left).
Normal left stifle is on left side of image. Red arrows point to the lateral fabella of right stifle in both images.
IRU in the lateral head of the right gastrocnemius muscle and remodeled bone noted on the lateral fabella.
AVULSION AND CYST-LIKE CHANGE AT ORIGIN OF RIGHT CAUDAL CRUCIATE OR MENISCOFEMORAL LIGAMENT. NO EFFUSION AND NO SUV DIFFERENCE COMPARED TO LEFT. CHRONIC DESMITIS.
INFLAMMATION

Fragment in situ, Right MCP.
Transverse CT and PET fusion images of abnormal right lobe of the thyroid.

Left subscapularis muscle – hypodense with peripheral contrast enhancement on CT and IRU on PET.
INFLAMMATION
RESULTS

PET and CT Findings

- Normal / incidental / abnormal
- Contributory / Non-contributory
- Anatomical location of clinical findings
- Primary pathology contributing to clinical Disease
- SUVmax normal / abnormal

Trends and Limitations

- Abnormal, contributory findings related to primary pathology
  - CT = Osteoarthritis and IVDD
  - PET = Soft Tissue Injury (FDG)
- Observational study of naturally-occurring disease
  - No control over the timing or severity of the disease process
DISCUSSION

CLINICAL RELEVANCE

- Molecular imaging adds functional, physiologic and metabolic information
  - Detect musculoskeletal lesions
  - Document lesion severity
  - Evaluate response to therapy
- Non-invasive, whole-body imaging
- Lack of uptake can also be useful

RECOMMENDATIONS

- Manage expectations
  - Understand the imaging mechanisms
  - Increase use and report findings
    - Controlled studies, serial imaging
- PET imaging recommended when:
  - Other modalities are non-diagnostic
  - Specific physiologic information provided by radiopharmaceutical
  - Whole Body imaging warranted
FUTURE DIRECTIONS

- Standardize techniques, analysis and interpretation
  - Objective evaluation of Disease and response to therapy
- Overcome limitations to canine imaging with New technology or techniques
  - Anesthesia vs. imaging during activity
  - Near real-time exercise evaluation
https://www.google.com/patents/US7126126


INCREASING LIGAND SPECIFICITY

Neurokinin-1

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CANINE MIXED BREED, MC, 8Y5M, FCU MUSCLE TEAR