Veterinary Radiation Oncology

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The Harrington Oncology Program

TUFTS CUMMINGS SCHOOL
of Veterinary Medicine
Areas of veterinary oncology

- Clinical service
- Teaching
  - Residency training
  - Veterinary student
- Research
  - Clinical research
  - Translational research
  - Basic research
Type of radiotherapy

- External beam therapy
  - Liniac, 60Co, orthovoltage unit
- Brachytherapy
- Plasiotherapy
- Radioimmunotherapy
- 131 iodine therapy
Radioiodine (I-131) : Feline Hyperthyroidism

- One injection
- Stay of less than one week
- No anesthesia
- Special music or audiotapes of your voice for your cat, and have a TV/VCR complete with a library of "Kitty Videos"
- Precautions primarily regarding your cat's litter box output at home
- You'd probably receive more radiation from an extended flight or a day at the beach than you'll get from your cat once it's released
- It must stay indoors for two weeks.
Veterinary Radiation Facility Survey 2001

- External beam
  - 42 sites: academic 40%, private 60%
  - Orthovoltage (3), linac (18), Cobalt 60 (12)
- 2790 dogs and 1081 cats
- No 1 disease: Mast Cell Tumor
- Three machines in Massachusetts
Similarity and difference

- **Similarity**
  - Biology of disease
  - Response
  - Side effects

- **Difference**
  - Combination therapy
  - Protocol
  - Cost
  - Anesthesia
  - No complain!
  - Cure??
  - Quality of life- euthanasia
Challenge

- Size of patient
- Irregular shaped body
- Patient care – silent
- Anesthesia
List of tumor

- **Dogs**
  - Soft tissue sarcoma
  - Melanoma
  - Lymphoma
  - Osteosarcoma
  - CNS tumor
  - Carcinoma
  - Mast cell tumor
  - Hemangiosarcoma
  - Advanced cancer

- **Cats**
  - Lymphoma
  - Soft tissue sarcoma
  - Squamous cell carcinoma
Comparative Cancer Research: Pet and Man

- Models for the study of cancer biology and treatment
- Spontaneous tumors with histopathologic and biologic behavior similar to tumors that occur in humans
- Shared environmental risk factors
- Shared tumor biology and behavior
- Similar responses to therapy
- May be shared similar gene mutation
- Accelerated clinical trials and biological studies
- Multi-modality protocols
- Fewer "gold standard" treatments, allows early and humane testing of novel therapies
- Excellent follow up
Foster Hospital for Small Animals

Approx. 24,000 cases annually
~75% dogs, 20% cats, and 5% exotics

- Anesthesiology (4)
- Behavior (2)
- Cardiology (3)
- Critical Care (5)
- Dentistry (1)
- Emergency (5)
- Exotics (1)
- Internal Medicine (6)
- Neurology (1)
- Nutrition (1)
- Oncology (5)
- Ophthalmology (2)
- Orthopedic Surgery (3)
- Radiology (5)
- Soft Tissue Surgery (3)
Harrington Oncology Program

● Personnel
  • 5 Faculty: Rad onc (2), Med onc (3)
  • 3 Resident: Rad onc (1), Med onc (2)
  • 5 Technical staff
  • Physicist
  • 4th year student
  • Residents completing program
    ▪ 10 medical oncology
    ▪ 1 radiation oncology

● Treatment offered
  • Chemotherapy
  • Radiation therapy
  • Surgery
Veterinary Radiation Oncologist

- Consultation for veterinarian
- New appointment
- Staging of cancer
- Therapy planning +/- 3D computer plan
- Set up
- Dose calculation
- Oversee therapists
- Patient care during a course of therapy
- Client communication
- Recheck examination
Radiation Therapy with Curative Intent

- **Human Medicine**
  - 2 Gy fractions daily
  - 6-8 weeks
  - 60-80 Gy total

- **Veterinary Medicine**
  - 3 Gy fractions
  - 3 - 4 weeks
  - 48 - 57 Gy total
Curative intent

Face near the eye

Chest wall: Scar
Advanced Tumors

- Palliative
- Alleviate clinical sign
  - Pain
  - Pressure
  - Progressive mass

Thyroid Carcinoma

Carcinomas

Cutaneous Hemangiosarcoma
Palliation-quality of life
Palliation-quality of life

Pre

Oral malignant melanoma

Carcinoma

Post
Equipment

- Radiation Therapy Unit
- CT
- MRI
- Digital radiography / fluoroscopy system
- Nuclear medicine
- Ultrasound
Linear Accelerator

Siemens Mevatron 77

- 6MV Photon
- Electrons: 6, 8, 10, 12, 15 and 18 MeV
- CT simulation station: AcQplan and AcSim
AcQplan and AcSim
CT based plan
Feline vaccine associated fibrosarcoma
Low Dose (1 Gy) Total Body Irradiation
Remission Analysis (Kaplan-Meier)

First remission duration (days)

Proportion in remission

Survival function

Censored
LDTBI

- Median remission time **56 weeks** is better than historical data after short induction protocol
- Some dogs benefit from LDTBI
- Thrombocytopenia was acute and potentially long term effect
- Fractionated LDTBI may reduce effects on platelets and enhance tumor control
Clinical Hyperthermia
Thermal Dose is Related to Duration of Local Control in Canine Sarcomas Treated with Thermoradiotherapy

Estimated survival distribution functions of time to local failure for a “typical” dog in the low and high thermal dose groups from a Cox proportional hazards model. There is a significant association between thermal dose group and time to local failure after controlling for total duration of heating, tumor volume and tumor grade (hazard ratio of low vs. high=2.28 (95% CI: 1.12-4.64); p-value=0.023). Duration of heating and tumor volume values used in the estimation of survival functions were median values for the respective group and overall, respectively. 

Htmin=total duration of heat treatment; median duration of heating in the thermal dose group was used in the plot. Stumvol=median tumor volume over all dogs in trial.
Kaplan-Meier survival distribution function estimates of time to local failure for dogs in the high thermal dose group. Total heating duration was divided into thirds for the analysis (n=21 dogs each curve). The longest heating duration is associated with shorter duration of tumor control.
Pretargeted immunoscintigraphy

Selected images of one study animal showing right lateral (top row) and dorsal (bottom row) views at 1 hour for $^{99m}$Tc-cMORF alone, $^{99m}$Tc-IgG alone and IgG-MORF followed at 3 days with $^{99m}$Tc-cMORF.
Biodistribution: Pretargeted

Figure 4. Distribution of activity in tissues for the three study groups.
Canine genomic project

- Searching cancer genes
- Particularly high disease incidence of cancer in certain breeds
  - Hemangiosarcoma in golden retrievers, German shepherd dogs
- Genetics plays an important role to develop certain cancers
- DNA samples from healthy golden retrievers and golden retrievers affected by particular cancer and search the small difference in the patterns of DNA specific for the cancer
- Development of genetic tests for carriers of the cancer
- Breeding control
- Development of treatment
- Identification of human cancer gene
Whole genome-wide association mapping using the Affymetrix arrays will be performed in breed 1. Regions of association will be refined, using a smaller number of individuals from other breeds. Affected individuals marked by red circle.
Interest and future in oncology

- Clinical application
  - Radioimmunotherapy
  - Tumor vaccine
  - Gene therapy
  - Immunotherapy
  - Anti-angiogenesis
  - Targeted therapy
- Canine Genome Project
- Cancer epidemiology and registry
- Alternative medicine
- Hospice care
Future veterinary cancer center: CSU

- Varian Trilogy System
  - IGRT (image-guided radiation therapy)
  - IMRT (intensive-modulated radiation therapy)
  - Stereotactic radio-surgery
Questions