Ferret Oncology: Diagnostics and Therapeutics

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- Important family members
- Increased demand for quality care
- Improved ability to diagnose neoplasia
- Unique features affect therapies
  - Delivery routes
  - Side effects

Neoplasia

- Most tumor types reported
- Incidence underdiagnosed
- Underreported
- Little information about treatment
- Less information about response
- No average survival times

Therapy

- Define goals
- Remain realistic
- Time, quality of life
- Survival vs. remission vs. cure

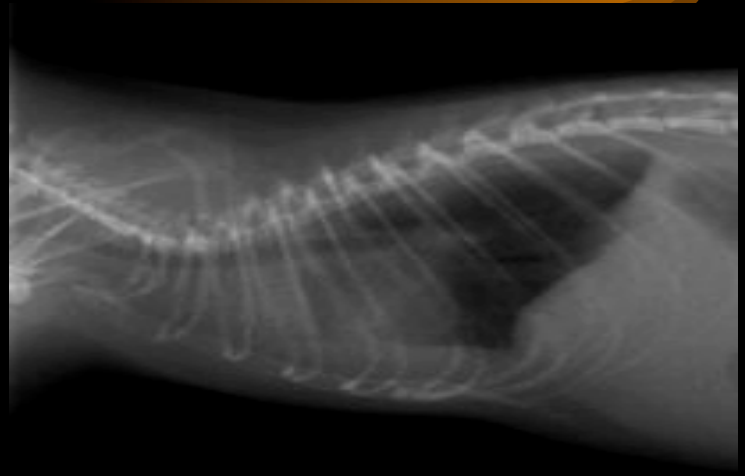
Oncology

- Diagnostics
  - tools
  - techniques
- Therapeutics
  - precautions
  - Modalities
- Ancillary Treatment
- Species Specifics

Diagnostic Concerns

- Unique anatomic features
- Normal physiologic states
- Lack of instrumentation
- Biopsy sample size
- Pathologist familiarity

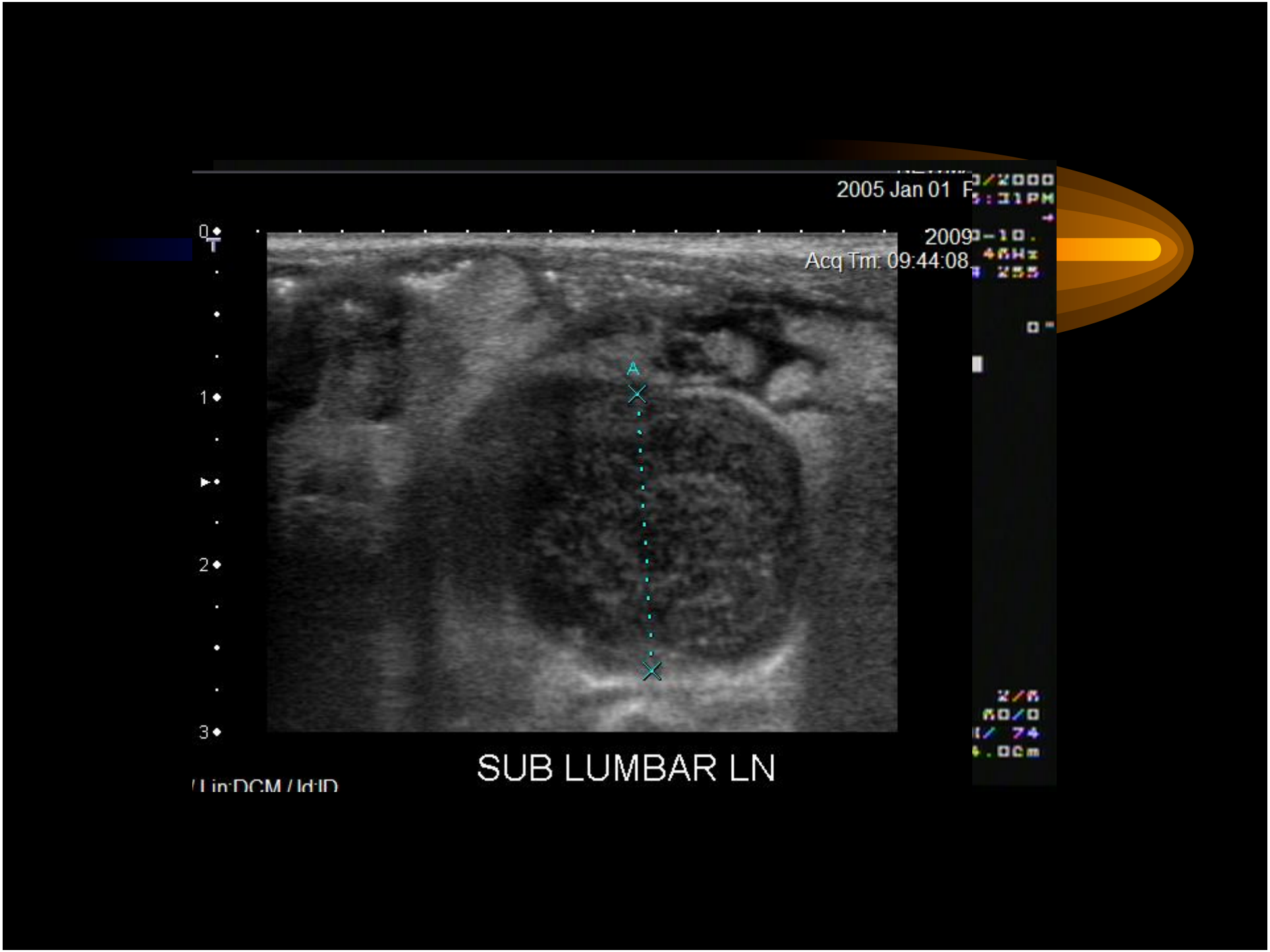
Diagnostics: Radiography



- Routine evaluation
- Detection of metastasis
- Follow-up/ response to therapy
- Contrast
- Fluoroscopy

Ultrasound

- Liver, heart, spleen, bladder, kidneys (GI)
- Enhanced by effusion
- Dependent on patient size
- Detects changes in architecture
- Poor assessment of lungs/thoracic space
- Useful to obtain aspirate/biopsy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SUB LUMBAR LN

Diagnostics: MRI, CT

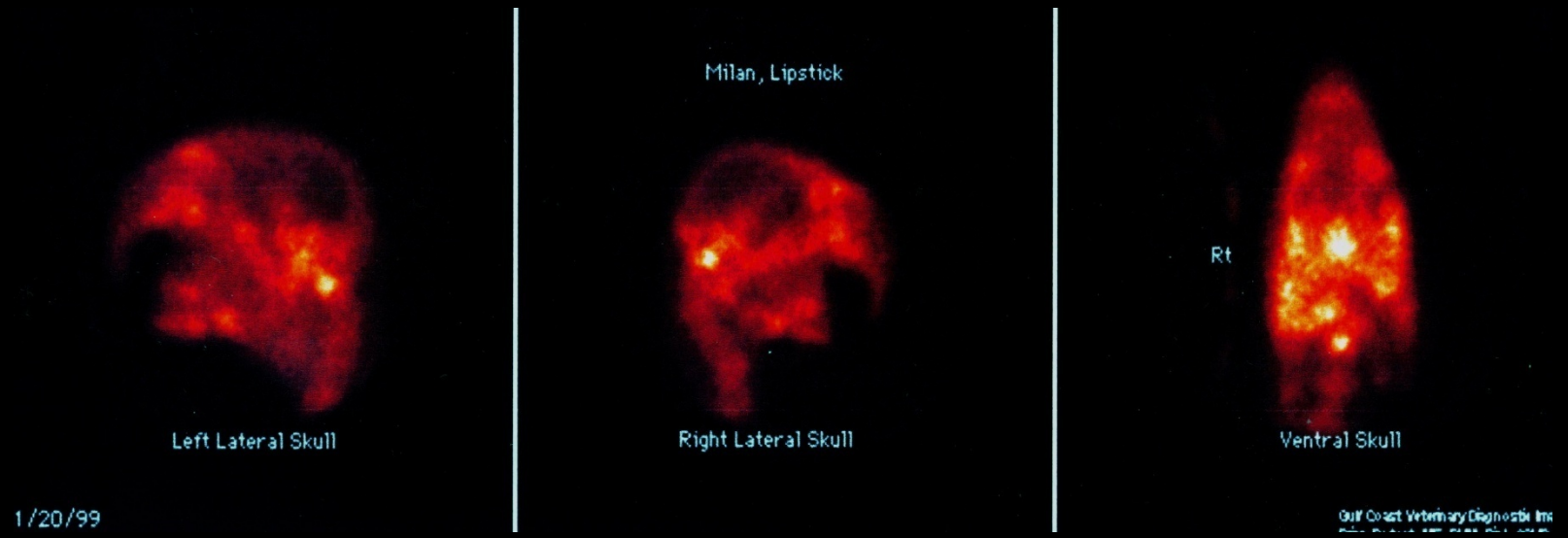
- Superior imaging of body cavity
- MRI: soft tissue
- CT: bone, air
- Requires anesthesia
- 2-3 mm slices

Diagnostics: Nuclear Imaging

Bone scans

- Osteoblastic activity
- Primary bony lesions
- Bone metastasis
- Systemic mets of osteogenic origin
- General anesthesia
- Special facility

Nuclear Imaging



Biopsy

- When?
  - alter type or extent of treatment
  - alter owner's willingness to treat
- Where?
  - junction of normal and abnormal
- How?
  - Depends on location, size, type
- If you take it off, SEND IT IN!!!

Diagnostics

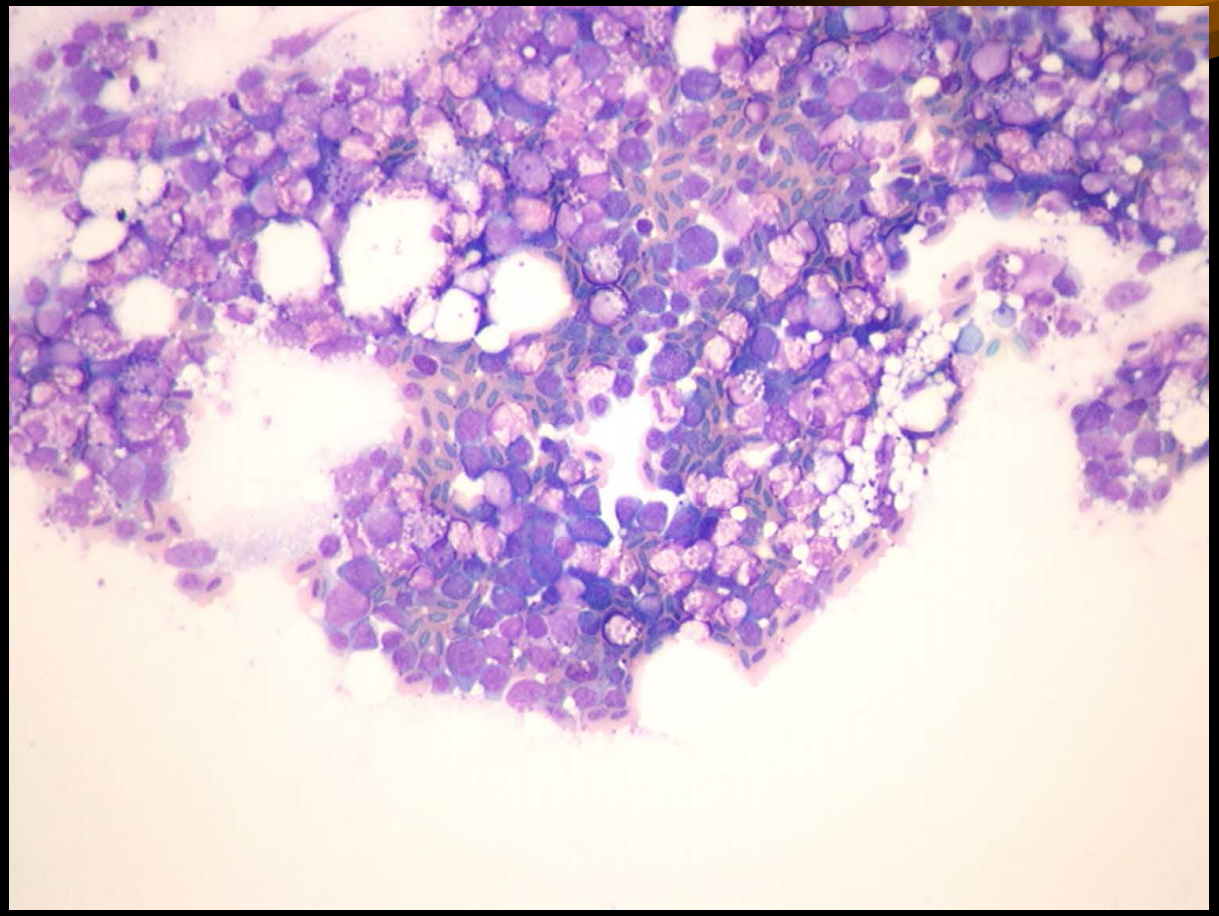
- Needle aspirates
- Bone marrow biopsy
- Bone biopsy
- Organ tissue biopsy
- Special stains

Fine needle aspirates

- 22- or 25-ga needle
- "Core" vs. aspirate
- Ultrasound-guided
- Sedate when necessary
- Splenic aspirates - awake

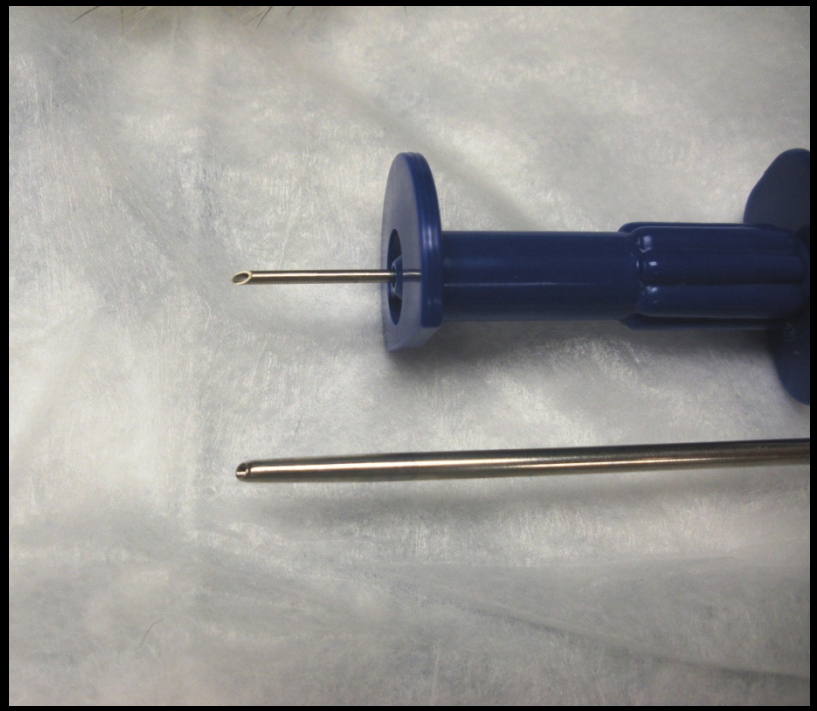
Bone marrow aspirate

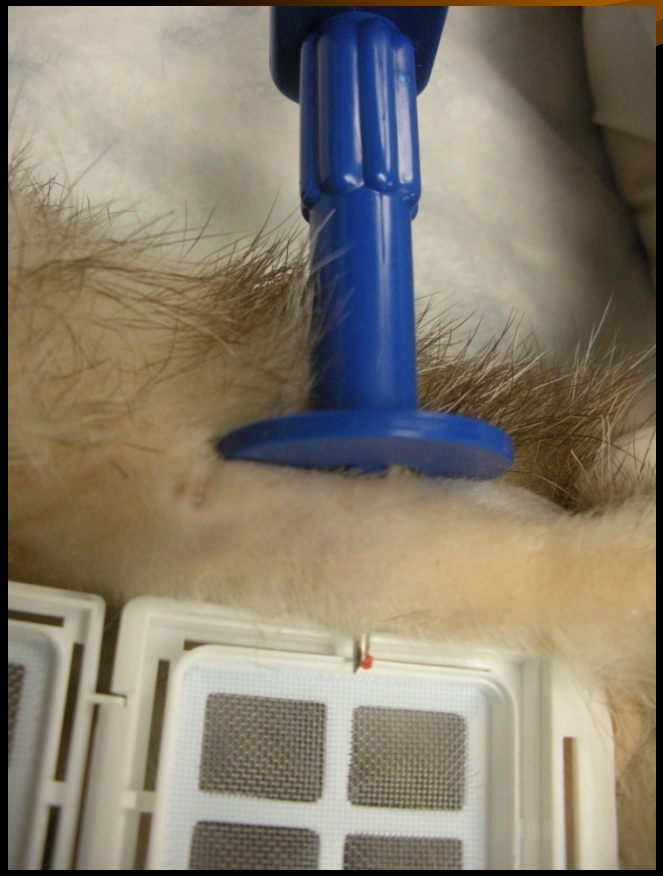
- Femur, tibia, humerus
- Standard bone marrow needles (18-ga)
- Spinal needles
- Standard needles for small patients
  - bone plug



Bone biopsy

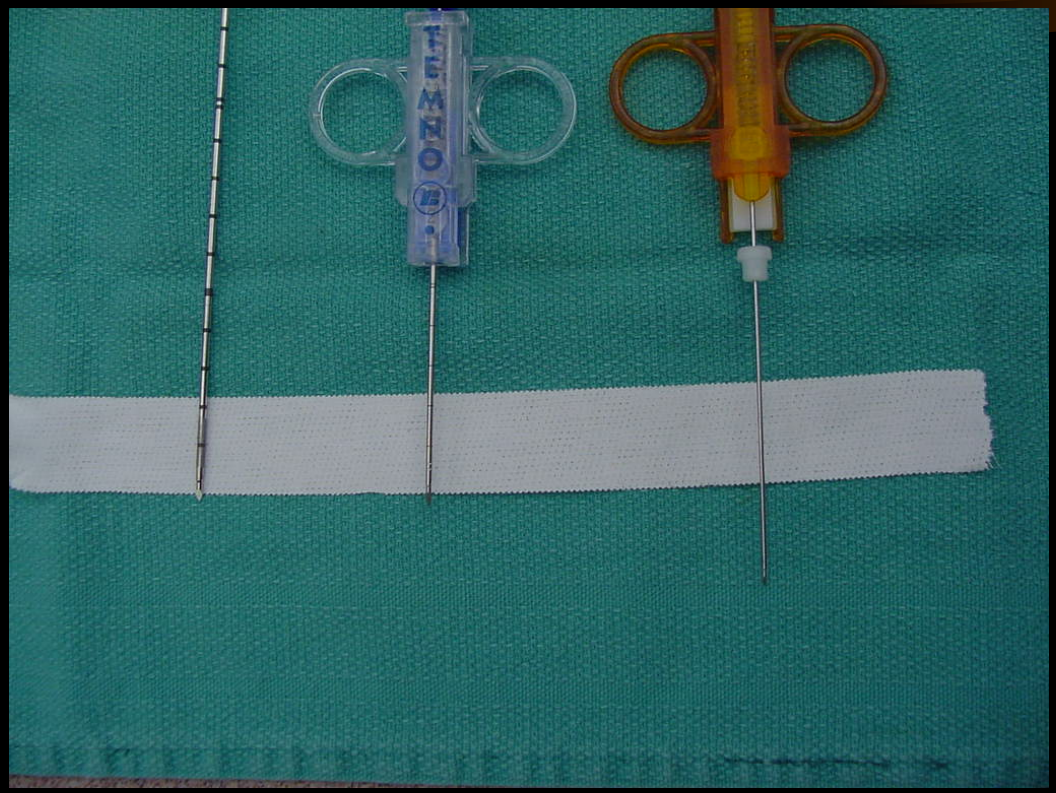
- Jamshidi instruments
  - too large, may fracture bone
- Spinal needle, standard needle
- Penetrate both cortices AND SKIN
- Use stylet to remove biopsy





Organ tissue biopsy

- Biopsy instruments
  - advances into tissue
- Endoscopy
  - 2.7 mm scope, Taylor sheath
  - 3-fr or 5-fr biopsy
  - rigid or flexible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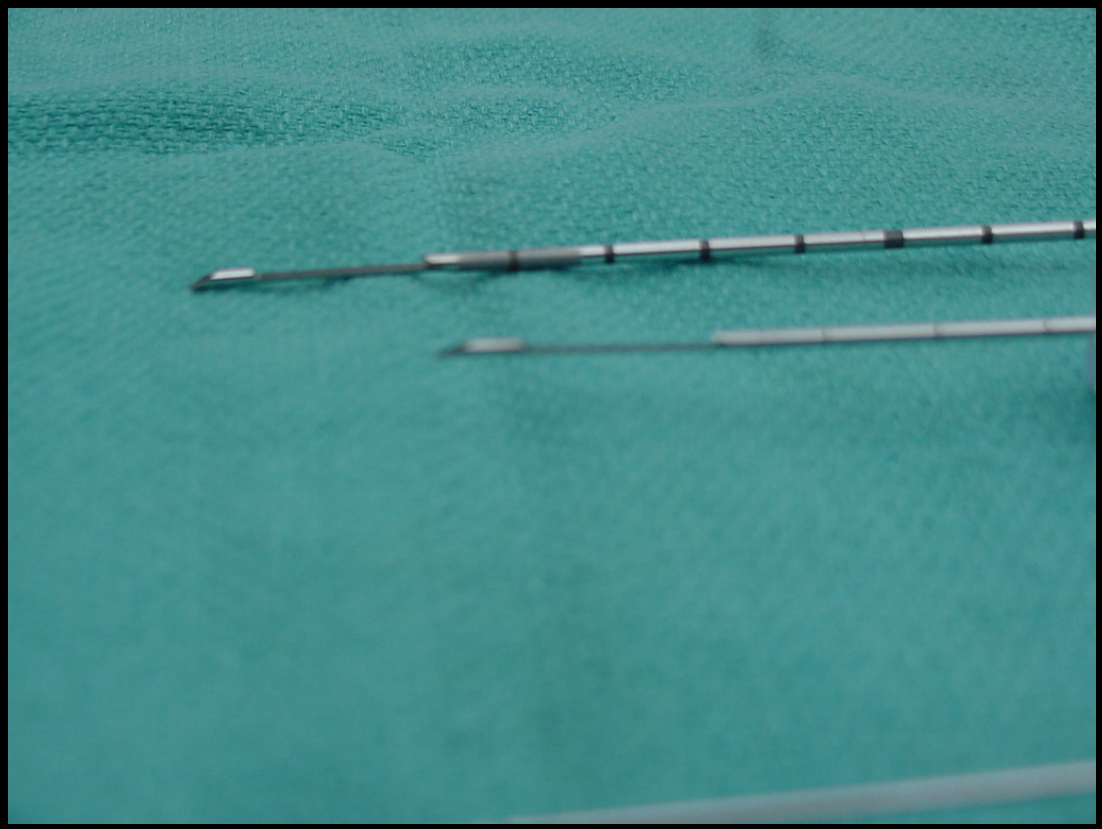
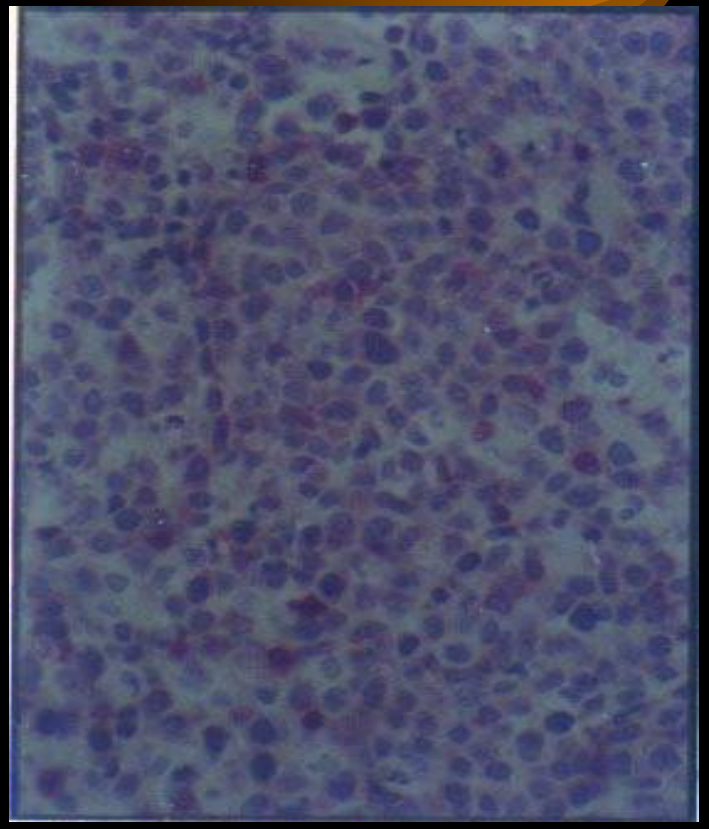


Enhancing diagnostic ability

- SAVE SLIDES!
- Special stains
- Fungal stains
- Acid fast
- Immunoflourescence
- Immunohistochemistry



Immunohistochemistry

- Antibodies
  - cell membrane or cytoplasmic antigen
- Does not provide a diagnosis
- CONFIRMS
  - histologic diagnosis
  - tumor type/cell line of origin
- Not available for all cells or species

Immunohistochemistry: Uses

- Lymphoma
- Differentiates B- and T-cell
- CD3 (T-cell), CD79a (B-cell), BLA36
  - non-surgical diagnosis
  - mesenteric lymph node aspirates
  - abdominal masses
  - peripheral lymph node aspirates

Immunohistochemistry: Uses

- Multiple-drug resistance
- Cell of origin
  - Undifferentiated sarcoma
  - -oma vs. -sarcoma
  - viral etiology
  - papilloma vs. carcinoma

Other options

- Flow cytometry
- Biomarkers
- Additional testing not yet available

Sample submission

- Histopathology
  - contact lab
- Saved slides
  - unstained, unfixed
- New sample
  - be sure sample correlates w/ original findings

Effective Diagnostic Sampling

- Many options available
- Save extra slides
- Modify common techniques
- Less invasive
- Less traumatic
- Greater patient safety
- Equally diagnostic

Ancillary treatment

- Optimize health
- Optimize environment/ husbandry
- Involve owners
- Address complications
- Quality of life

Nutritional support

- Meet/exceed caloric needs
- wound healing
- improve recovery
- enhance metabolism
- cell division
  - target of chemotherapeutics

- Cachexia is a complex metabolic syndrome defined as generalized wasting and loss of body mass that is usually associated with a chronic disease process and is often not reversible by increasing caloric intake alone

Nutritional support

Cancer cachexia

- paraneoplastic syndrome
- progressive involuntary weight loss
- adequate nutritional intake
- decreased survival time - humans
- changes may persist after resolution

- Cachexia ≠ starvation;
  - starvation : ↓ metabolism to compensate
  - cachexia ↑ rate of calorie consumption
- Malnutrition is the earliest stage of cachexia
- Weight loss significant @10% of normal

Nutritional support

Cancer cachexia

- glucose, protein, nitrogen, carbohydrate metabolism
- tumor cells - anaerobic glycolysis
- end product - lactate
- lactate converted to usable form - energy
- tumor gains energy
- patient loses energy

- There is a proven higher risk of death from disease in human patients with cachexia than those with the same disease that do not develop cachexia

- Loss of 1/3 of the body protein in humans causes death in less than one month

Nutritional support

- Protein, amino acids
  - improved immune response
  - GI function
  - surgical healing
- Lipid poorly used by tumors
- High-fat, low carb diet (Omega-3)
  - higher remission rate
  - longer survival time

Nutritional support

- MER = 1.5 x BMR
- BMR = kW $^{0.75}$ (k=70)
- Adjust for health status
- Gavage feeding
- TPN, PPN
- Encourage enteral feeding

Nutritional Support

- Nutritional support
  - Carnivore products
  - Max-cal, A/D
  - Baby food (meat only)
  - 'Duck soup'
  - (Ensure??)

Gastrointestinal support

Vomiting:

- CRTZ**
  - chemical stimuli
- cerebral cortex
- peripheral receptors*
  - direct - chemotherapeutics
  - indirect - effects of chemo
- vestibular apparatus

Gastrointestinal support

- Antiemetics
  - Metoclopramide (Reglan)
    - acts at CRTZ
  - Ondansetron (Zofran)
  - Cerenia
- Anti-ulcer
  - famotidine, ranitidine, cim
- GI protectants
  - carafate, pepto-bismol

Blood products

- Epogen (erythropoietin)
  - anemia, normal marrow precursors
- Nupogen (G-CSF)
  - severe leukopenia/heteropenia
- Oxyglobin
  - increases O2 carrying capacity
- Blood transfusion

Antioxidants

- Vitamin E
  - radiation therapy
- Vitamin C
  - immunostimulant
- Milk thistle (silymarin)
  - liver
- S-adenosylmethionine (S-amE)

Miscellaneous

- Blood donor pool
- Amputee book
- Survivor book
- Contact other pet owners

Therapeutics

- Multiple modalities
- Combination therapy
- Adjust to individual needs
- Close patient monitoring
- Supportive care
- Maintain optimal health

Radiation therapy

- Induced vascular injury
- Progressive
  - Small vessel occlusion
  - Tissue hypoxia
  - (lymphedema)
- Parenchyma cells depleted
- Fibroblasts depleted

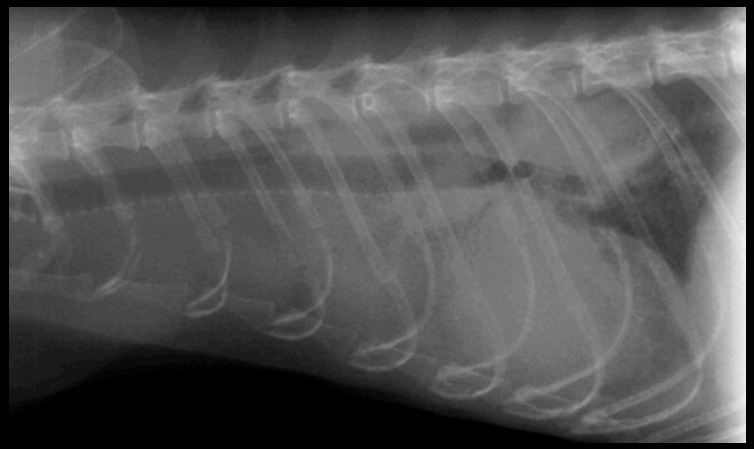
Radiation therapy

- Rapid cellular destruction
  - consider steroid at first treatment
- Effects continue 6-8 weeks
- Cutaneous burns
- Necrosis
- Organ damage in field

Radiation therapy

- Surgery ➡ radiation
  - radiation immediately after surgery
  - radiation 10-14 days post-op
  - complications highest 1-10 day window
- Radiation ➡ surgery
  - 4-6 weeks post-radiation
- Radiation changes continue post treatment

- Prior to RT



•6 weeks of RT

Complications

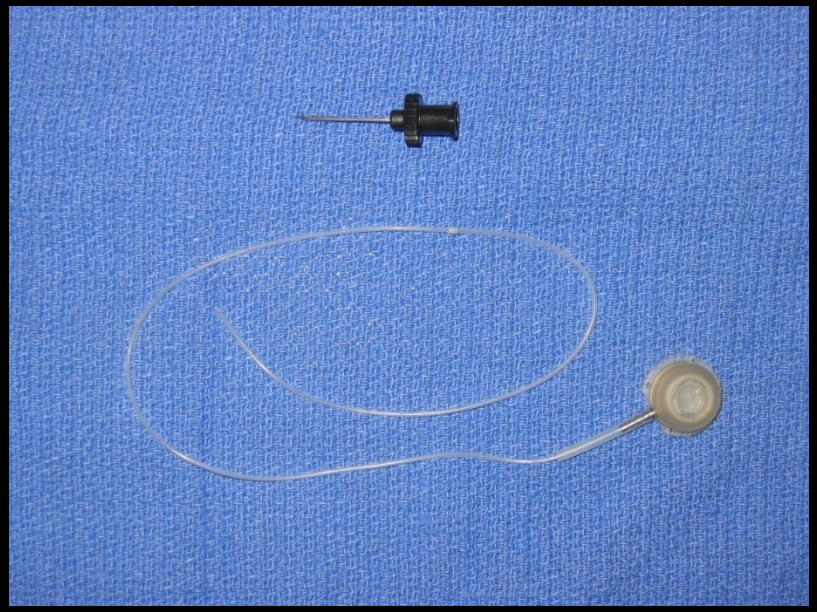
- Tissue contracture
- Necrosis
  - soft tissue
  - bone
- Tissue atrophy
- Delayed wound healing

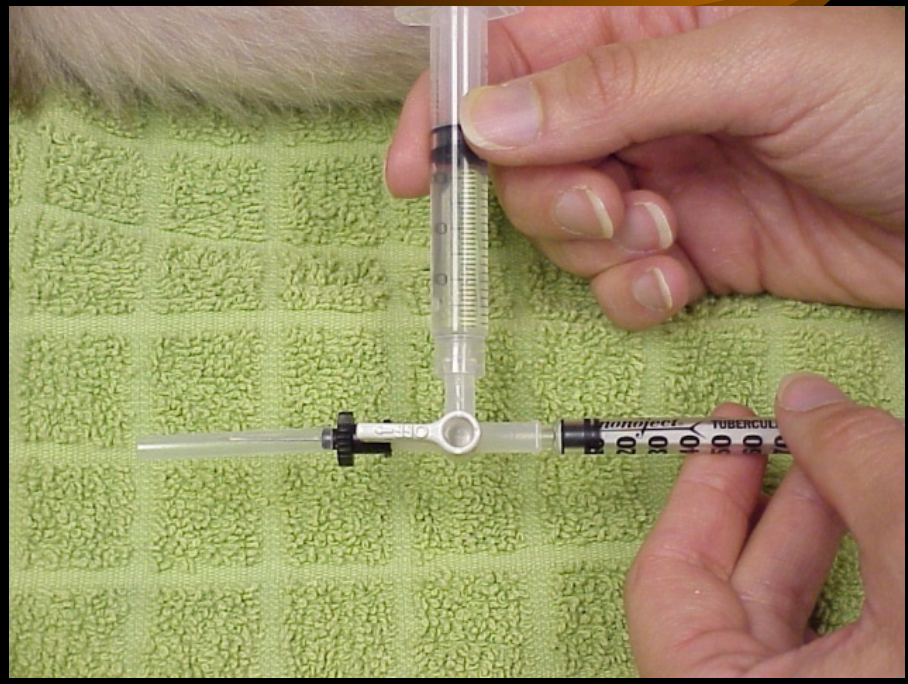
Chemotherapy

- Venous access
- Intravenous
  - sedation and catheterization
  - clean stick
  - appropriate sites
  - 22, 24, 26-ga needles
- Intraosseous
- Vascular access port

Chemotherapeutics

- Vascular access port
  - minimum size 1.2 Fr
  - varying lengths and septums
  - Huber needles (20-24-ga)
  - enables blood sampling
  - surgical prep for each use





Chemotherapy

- Evaluate CBC
  - Total WBC
  - Neutrophils >1000
  - if lower, postpone 3-7 days
- Evaluate patient
- Use alternate vein for chemo

Low wbc/infection

- Low wbc, routine check
  - Antibiotics, fluids – home care
- Low wbc, diarrhea, illness
  - Hospitalize, IV fluids, antibiotics
- Fever
  - Hospitalize, IV fluids, antibiotics

Patient Precautions

- Steroid tolerant
- Immunosuppression
  - Fungal colonization
  - Candida (GI)
  - Sepsis
- Consider prophylactic treatment
- Monitor closely

Human Precautions

- Mix in biohazard hood
- Wear gloves to mix and administer
  - Double glove (latex)
  - Chemotherapy gloves
  - Clean cages
- Mask, gown
- Eye protection

Human Precautions

- Waste disposal
  - Wear gloves
- Medication administration:
  - Wear gloves, eye protection
  - Avoid spills
  - DO NOT split pills

Retinoids

- Retin-A, Accutane, Vesanoid
- Lymphoid & epithelial cells
  - affect maturation and differentiation
  - alters gene transcription
- Benign epithelial cell tumors
- Cutaneous T-cell lymphoma
- Combine with surgery
- Synergistic with interferons

Interferons

- Roferon-A, Intron-A
- Immunomodulators
- Cell surface receptors
  - alters nuclear DNA transcription
- Synergistic with retinoids
  - Cutaneous T-cell lymphoma
  - Benign epithelial tumors
  - Combined with surgery

Miscellaneous agents

- Prednisone/prednisolone
  - complement to chemotherapy
  - excellent in lymphoid neoplasia
  - immunosuppressive effects

Chemotherapeutics

- Intralesional chemotherapy
  - sesame oil or plasma
  - multiple injections into mass
- Semi-permeable membranes
- Biodegradable polymers
  - high doses locally
  - complications

Complications

Extravasation

- Intervene immediately
- Avoid hanging limb
- *en bloc* excision??
- releasing incisions??
- debridement/bandage changes
- skin flaps

Photodynamic Therapy

- Injectable photosensitizer
- Irradiation
  - sensor concentrated in tumor
  - activated by irradiation
- Photofrin - approved
- Photochlor
  - 14 hrs post-inject vs. 24 hours (birds)
  - cell killing does occur

Species Specifics

- Common neoplasms
- Unique considerations
- Vascular access sites
- Immunosuppression consequences
- Changes

Ferrets
Common Tumors

- Adrenocortical adenoma, adenocarcinoma
- Insulinoma
- Lymphoma
- Cutaneous mast cell tumors
- Carcinoma

Ferrets
Therapeutics

- Cephalic, lateral saphenous
  - Penetrate skin prior to catheterization
- Vascular access port
  - jugular, femoral
  - 3 Fr
- Steroid tolerant
  - many receiving prednisone therapy
- Anesthesia tolerant

Ferrets
Adjunct therapy

- Good tolerance for chemotherapeutics
  - Hair loss
- Normal WBC 3,000-7,500
  - 1,000 (1,500?) prohibits treatment
  - standard antimicrobials
- Nutritional support
  - force feed
  - TPN

Vaccinations

- Stimulate immune system
  - May induce recurrance
- Avoid in ferrets who have received chemotherapy
- Nothing to stimulate immune system!!!
- JUST SAY NO!!!

Miscellaneous

- Oral vs. injectable chemotherapy?
- Exposure to other ferrets? Other animals?
- Duration of remission? Are they cured?
- What if there is recurrence? Is it all over?

Cancer

- Many options available
  - diagnostic and therapeutic
  - adapt common techniques
- Consult other areas of expertise
- Optimize environment
- Optimize patient health

Treating Cancer

- Involve owners
- Choose quality of life
- Keep complete data
  - Survival times
  - Limited published information
  - Negative experiences valuable
- Disseminate information
- Not a death sentence!