Diagnostic imaging in Veterinary Practice: The role of the Vet

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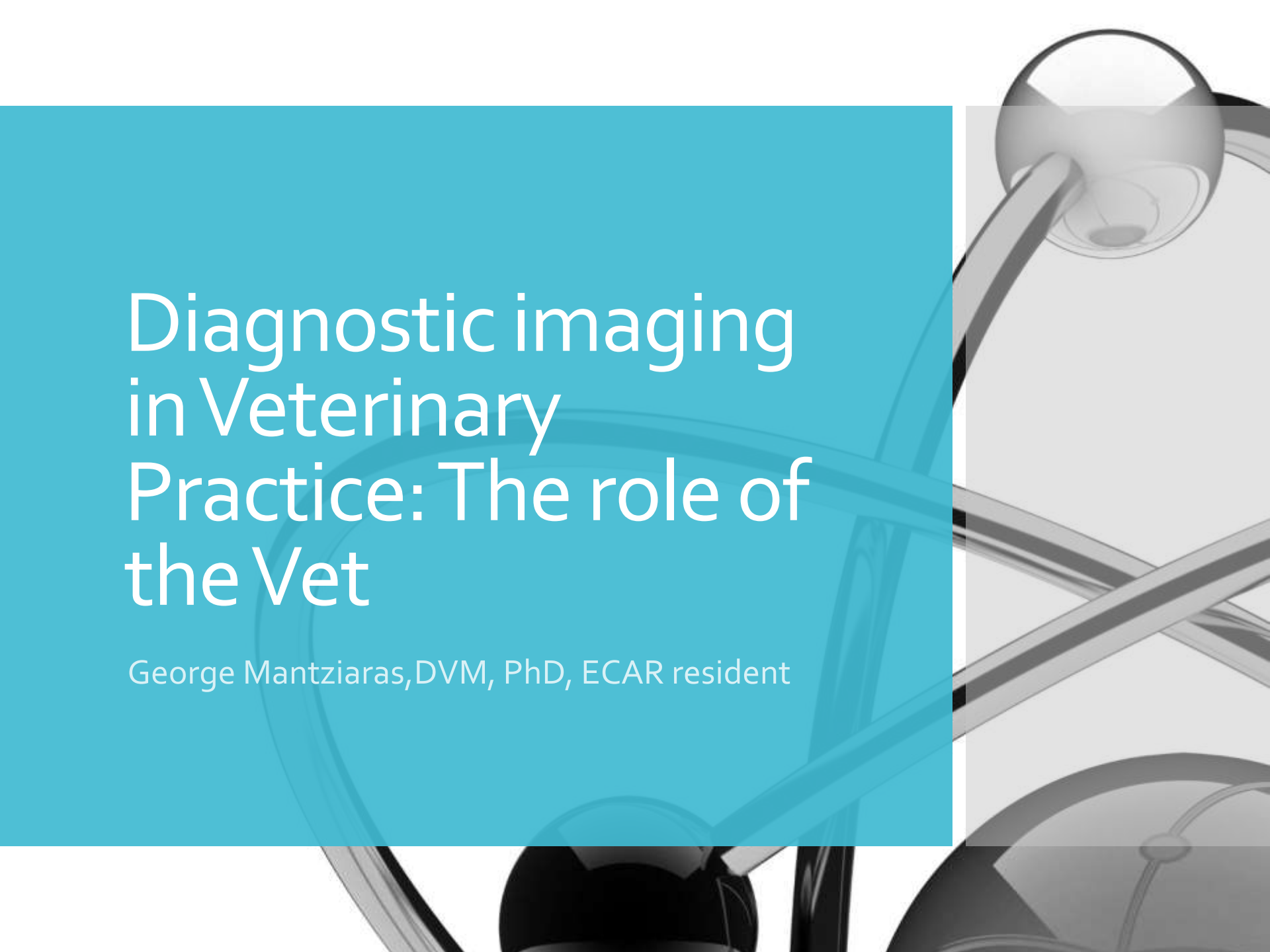


Introduction

Introduction

- Diagnostic imaging in Veterinary practice
- Why being a Vet is something special
- Effects of ionizing radiation
- Radioprotection in small animal practice
- The role of the Vet

Diagnostic imaging in veterinary practice

Diagnostic imaging in veterinary practice

- Radiology
- Fluoroscopy
- CT
- MRI
- Ultrasound

Diagnostic imaging in veterinary practice

Wilhelm Conrad Roentgen

Diagnostic imaging in veterinary practice

8 November 1895

Nobel Physics, 1901

Diagnostic imaging in veterinary practice

Types of radiation

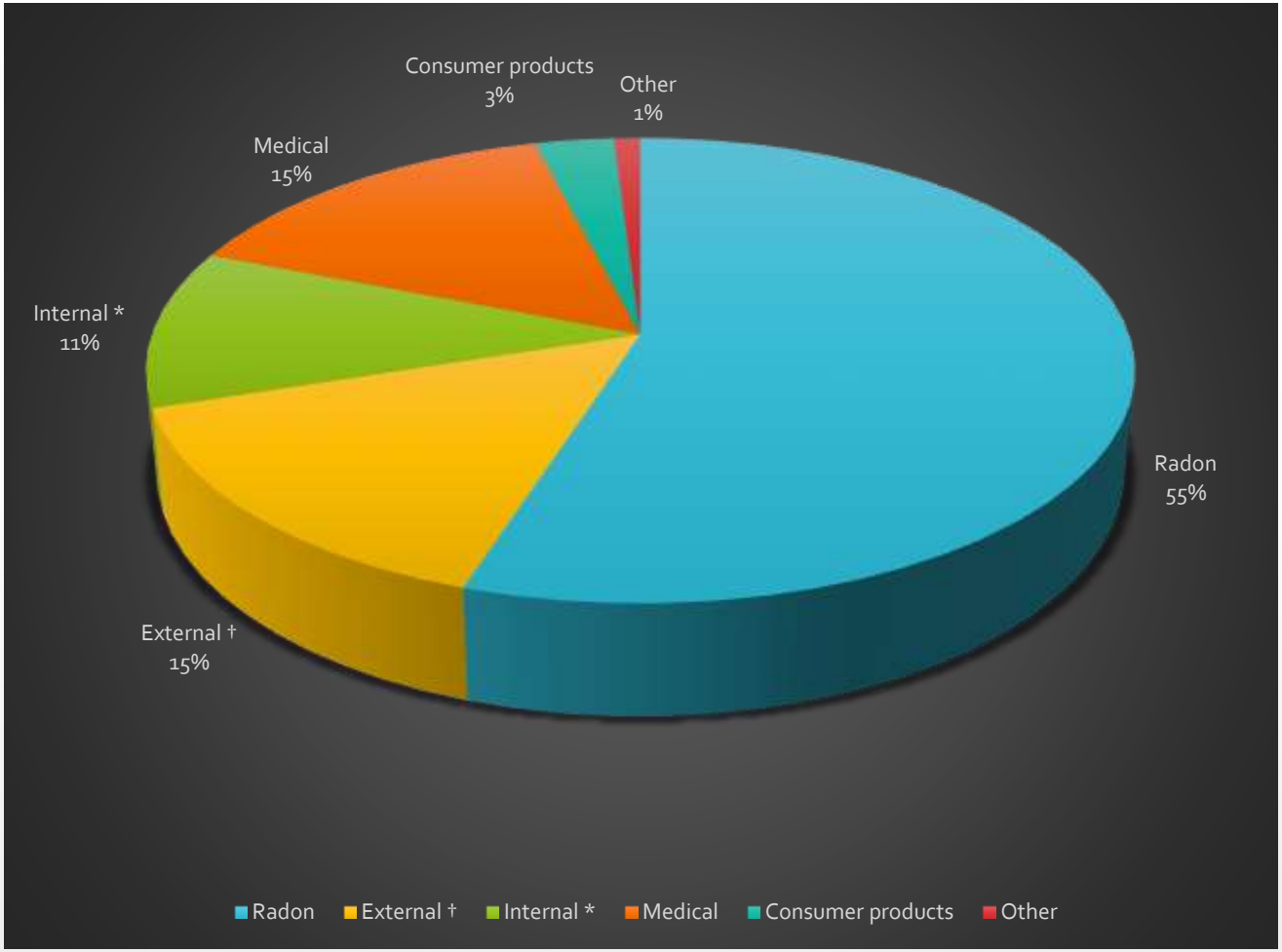
- Non ionizing radiation
  - Thermal radiation
  - Very low and extremely low frequency fields
  - Radio waves
  - Ultraviolet light
  - Visible light
  - Infrared etc
- Ionizing radiation
  - X-rays
  - Gamma radiation
  - Alpha radiation
  - Beta radiation

Diagnostic imaging in veterinary practice

Ionizing radiation?

- Radiation with sufficiently high energy that can ionize atoms
- Ionization: the process by which an atom or a molecule acquires a negative or positive charge by gaining or losing electrons to form ions, often in conjunction with other chemical changes

Diagnostic imaging in veterinary practice



*—Exposure from radioactive materials in the body (potassium 40 and carbon 14 from food, radon from water)
†—Exposure from radioactive materials in the environment (natural gas, building materials, nuclear and coal power plants)

Diagnostic imaging in veterinary practice

- Radiology
- Fluoroscopy
- CT
- MRI
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Diagnostic imaging in veterinary practice

- Radiology
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} *X-rays*

Diagnostic imaging in veterinary practice

- Radiology
- Fluoroscopy
- CT
- ~~MRI~~
- ~~Ultrasound~~

X-rays

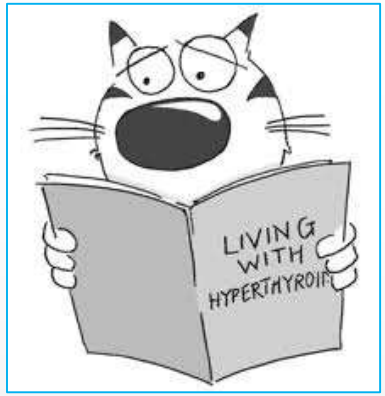
Diagnostic imaging in veterinary practice

- Radiology
- Fluoroscopy
- CT
- ~~MRI~~
- ~~Ultrasound~~
- **Radiation oncology**

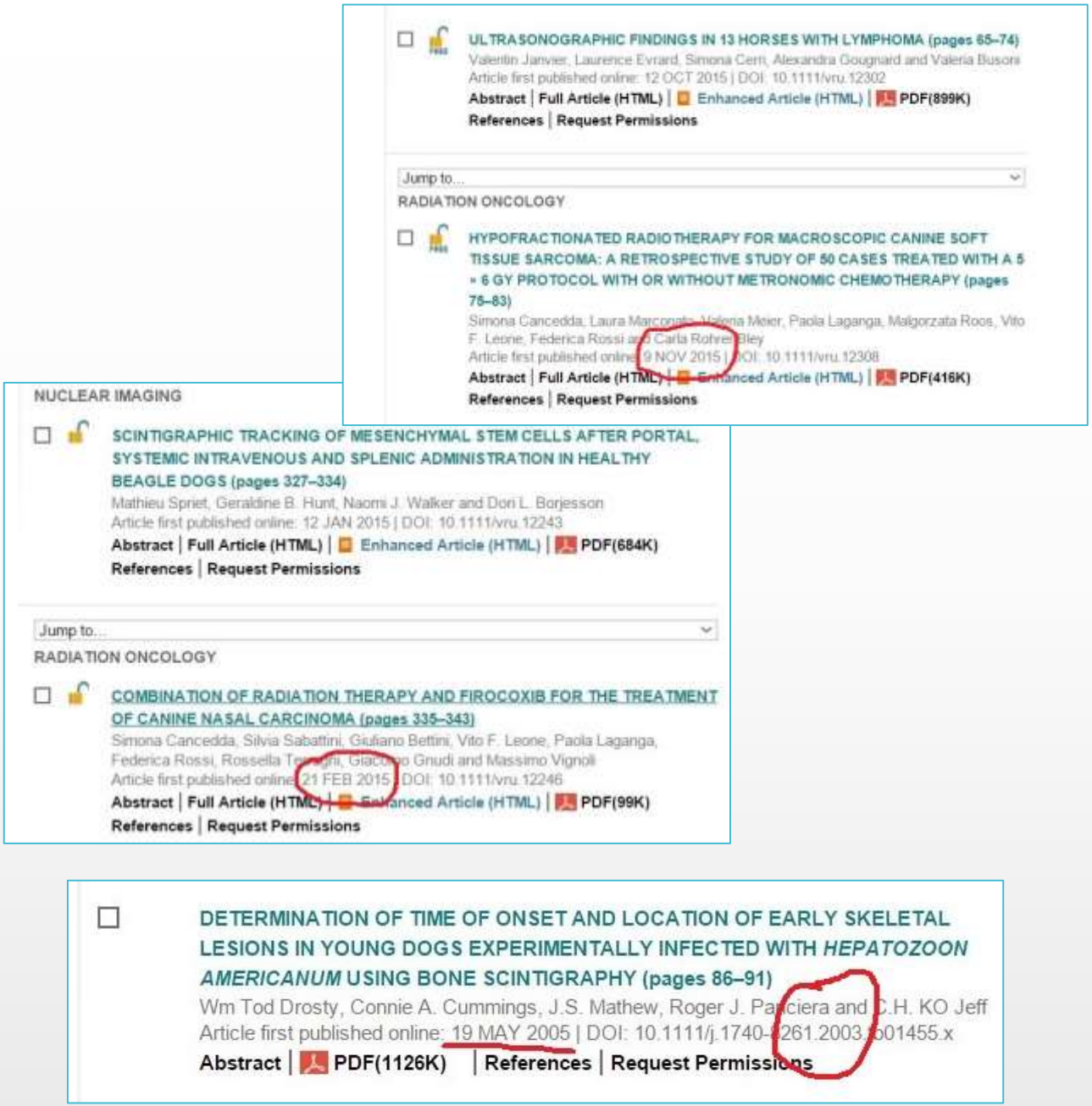
Diagnostic imaging in veterinary practice

Feline Hypothyroidism

- Diagnosis:
  - Scintigraphy
    - I-131 (half-life 8.1 d)
    - I-123 (half-life 13.1 h)
    - $^{99mt}TcO_4$ (half-life 6.0 h)
- Treatment:
  - Antithyroid drugs
    - Methimazole
    - Carbimazole
  - Surgery
  - I-131 → 95-98% successful treatment
    - 3d – 3w hospitalization



Diagnostic imaging in veterinary practice



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Diagnostic imaging in veterinary practice

Table 1. Common Medical Applications of Nonionizing and Ionizing Radiation

Type of radiation	*Medical application*
Ionizing	
Gamma rays	Nuclear medicine
	Positron emission tomography
	Radiation therapy
	Single-photon emission CT
X-rays	Computed radiography
	CT
	Digital subtraction angiography
	Duel-energy x-ray absorptiometry
	Fluoroscopy
	Mammography
	Radiation therapy
	Radiography
Nonionizing	
Electromagnetic and radio frequency waves	Magnetic resonance imaging
Ultrasound	Ultrasonography

CT = computed tomography.

Special issues of veterinary profession

Special issues of veterinary profession

- Vets are the handlers
- Too many women!

(with a tendency to increase more…)

- Protection of the owner
- Protection of the animal (?)
- Patients are not always cooperative….

Special issues of veterinary profession

Modern Vet must be ….

Special issues of veterinary profession

Modern Vet must be ….

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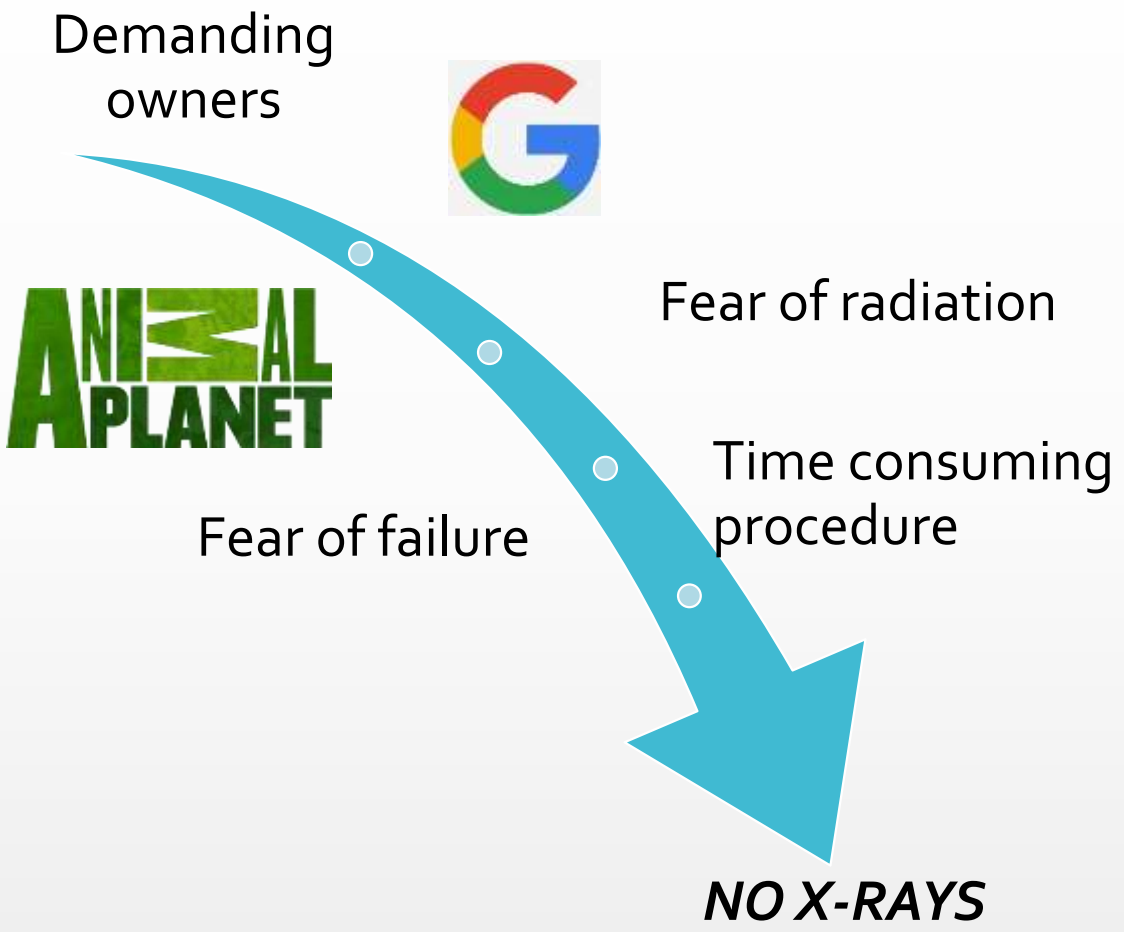
Special issues of veterinary profession



Biological effects of ionizing radiation

Biological effects of ionizing radiation

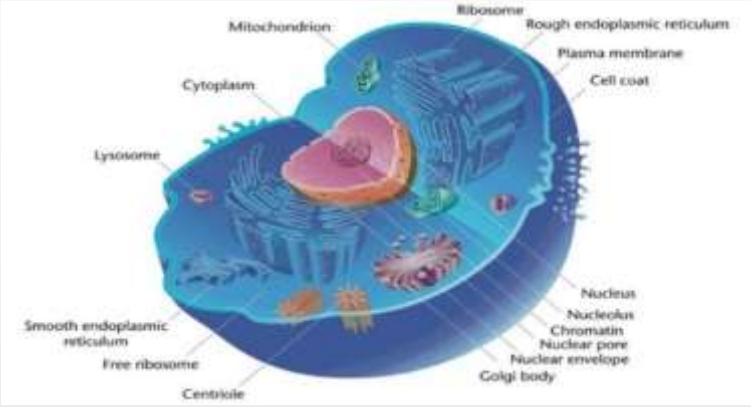
Radiation causes ionization of **atoms**

- which may affect **molecules**
- which may affect **cells**
- which may affect **tissues**
- which may affect **organs**
- which may affect **the whole body**

Biological effects of ionizing radiation

Cellular damage

1. Direct effect
2. Indirect effect
   - Radiolytic Decomposition of Water in a Cell



Biological effects of ionizing radiation

Cellular Sensitivity to Radiation

- Not all living cells are equally sensitive to radiation
- Cells which are actively reproducing are more sensitive
- From most to least sensitive:
  - Lymphocytes and Blood Forming Cells
  - Reproductive and Gastrointestinal (GI)
  - Cells Nerve and Muscle Cells

Biological effects of ionizing radiation

Organ Sensitivity

- Sensitivity of various organs correlates with the relative sensitivity of the cells from which they are composed
- From most to least sensitive:
  - Blood Forming Organs
  - Reproductive and Gastrointestinal Tract Organs
  - Skin Muscle
  - Brain

Biological effects of ionizing radiation

Whole Body Sensitivity Factors

- Total Dose
- Type of Cell
- Type of Radiation
- Age of Individual
- Stage of Cell Division
- Part of Body Exposed
- General State of Health
- Tissue Volume Exposed
- Time Interval over which Dose is Received

Biological effects of ionizing radiation

Radiation Effects

- High Doses (Acute)
  - Tend to kill cells
  - Tissues and organs are damaged
  - Rapid whole body response → Acute Radiation Syndrome (ARS)
- Low Doses (Chronic)
  - Tend to damage or change cells
  - Low doses spread out over long periods of time don't cause an immediate problem
  - The effects of low doses of radiation occur at the level of the cell
  - The results may not be observed for many years

Biological effects of ionizing radiation

Exposure to Low Doses of Radiation

- Genetic Effects
  - Mutation of the reproductive cells passed on to the offspring of the exposed individual
- Somatic Effects
  - Effect is suffered by the individual exposed
  - Primary consequence is cancer
- In-Utero Effects
  - Intrauterine Death
  - Growth Retardation
  - Developmental Abnormalities
  - Childhood Cancers

Radioprotection in the small animal practice

Radioprotection in the small animal practice

AIMS OF IMAGING

- Maximum of diagnostic informations
- Minimum exposure of animals-personnel-owners

AIMS OF RADIOPROTECTION

- Prevention of important effects of radiation, observance of the suggested doses and limits
- Minimize of somatic, genetic and in-utero effects, in relationship with the benefits and the social needs and values

These goals can be achieved with the application of *ALARA principle*

- *Exposure to radiation As Low As Reasonably Achievable*

Radioprotection in the small animal practice

- Reduction of exposure:
  - Increase the distance between you and the radiation source
  - Reduce the time of exposure
  - Lead or lead equivalent shielding - personal protective equipment
- Monitoring of personnel:
  - Check adequacy of radioprotection
  - Highlighting radioprotection problems
  - Highlighting cases of personnel exposure

Radioprotection in the small animal practice

- Shielding
  - Lead aprons
  - Mobile lead shields
  - Lead glasses
  - Lead barriers
- Personal protective equipment
  - Lead aprons
  - Gloves
  - Thyroid collars
  - Eyewear etc

Radioprotection in the small animal practice

Radioprotection in the small animal practice

Radioprotection in the small animal practice

RADIOPROTECTION RULES:

- "Throw away" from the exam room incompetent people
- Ban pregnant women and persons < 18 years
- Labeling: Post notices to display appropriate warnings
- Rotation of personnel involved
- Use restraint equipment
- Use sedatives (whenever possible)
- No part of the body should reach the x-ray beam
- Do not hold the x-ray machine with your hand during the exam

Radioprotection in the small animal practice

RADIOPROTECTION RULES:

- Use protective personal equipment
- Wear protective gloves if your hand are close to the beam
- Wear protective glasses
- Wear thyroid collar
- Inspect periodically the focus of your x-ray machine
- Make adjustments to limit time settings
- Inspect periodically the adjustments of your machine

The role of the Vet…

The role of the Vet…

Multidimensional, as the Vet should:

- Know the biological effects of ionizing radiation
- Know the principles of radioprotection
- Should train his personnel
- Should know his x-ray machine
- Should know hoe to position the animal
- Should check his personnel if they follow the procedures

The role of the Vet…

- Should inform the owners
- Should know how to interpret his radiographs
- Should know how to use sedative and anesthetic drugs
- Should know the pros and cons of each diagnostic imaging modality
- Should choose the most suitable one, depending the case
- Should renew equipment
- Should….
- Should….
- ……

Finally…

Finally…

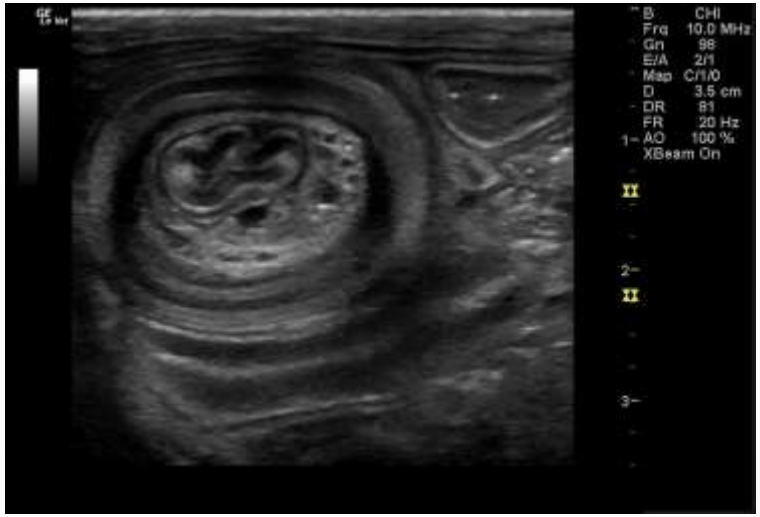
Evolution of x-ray machines

Digitization

Finally…

- Improved education of Veterinarians
- Specialization
- Use of alternative diagnostic modalities

Finally…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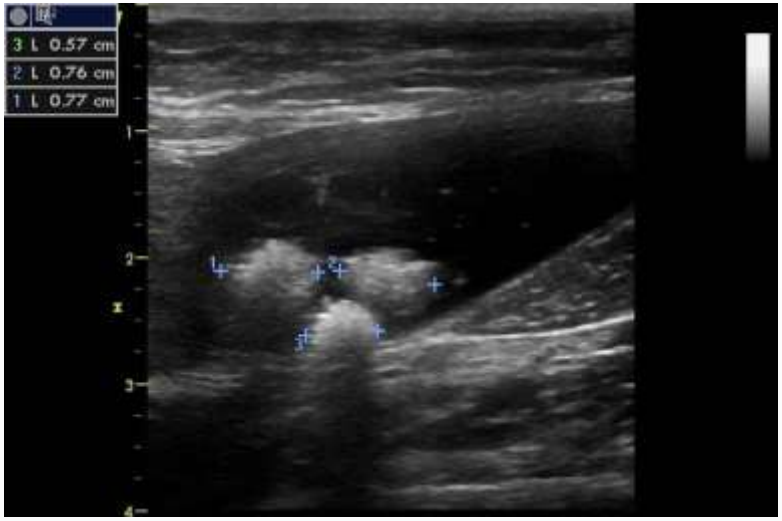
Finally…



Radiology

- Valuable diagnostic tool
- Irreplaceable
- Countless applications
- (Can be) a safe diagnostic imaging modality

May the force be with you…

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