

**COLLEGE OF VETERINARY MEDICINE  
UNIVERSITY OF AGRICULTURE  
ABEOKUTA NIGERIA**

**LECTURE NOTES**

**COURSE TITLE: VETERINARY ORTHOPEADICS  
AND RADIOLOGY**

**COURSE CODE: VCS 502**

**COURSE UNIT: 2**

**LECTURER**

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# LECTURE I: INTRODUCTION TO NEURO-RADIOLOGY

(INDICATION; RADIOGRAPHY OF THE SKULL; MYELOGRAPHY;  
TECHNIQUES AND INTERPRETATION)

## INTRODUCTION

- Neuro-radiology deals with the use of x-rays, radioactive substances/radiant energy in the diagnosis and management of diseases affecting the nervous system.
- The nervous system comprises of the central (brain & spinal cord) and the peripheral (motor nerves & ganglia) systems.
- Radiological investigation usually involves the skull (brain) and the spinal cord (myelography).

## RADIOGRAPHY OF THE SKULL

### INDICATION

- Evaluation of patients with clinical signs that suggests involvement of the bone, sinuses, nasal passages, teeth, eyes and orbits, brain, oral cavity and external soft tissues.
- Clinical signs such as nervousness, seizures, dizziness, in-coordination (ataxia) sinusitis, epistaxis etc.
- Tumours/Neoplasm of the brain tissue on any part of the skull is often an indication for skull radiography.
- Fracture of the skull due to trauma (mandible, maxilla, zygomatic processes e.t.c.)
- Luxation of the temporomandibular joint
- Nasal foreign bodies (wire, metal fragment, grass, straw etc)

## **POSITIONING TECHNIQUES**

- Multiple projections of the skull may be necessary for full evaluation of pathologic changes.
- Commonly used radiographic views are lateral, ventro-dorsal and dorsoventral (others are open-mouth lat. view, lat. oblique view etc).
- To obtain the precise positioning required, anaesthetize the patient and give the skull necessary support.

### **LATERAL VIEW**

- Indicated for evaluating the nasal area and calvarium
- Position the skull in true lateral recumbency.
- Elevate the nose rostrally and rotate the head dorsally using radiolucent supporting materials e.g. wedge-shaped radiolucent foam.

### **VENTRODORSAL VIEW**

- Position the animal in dorsal recumbency with its head and cervical spine in a straight line while the mouth is opened and the palate is parallel to the film.
- Indicated for evaluating the mandibles, calvarium, zygomatic arches and temporo-mandibular joints.

### **DORSOVENTRAL VIEW**

- Place the animal in sternal recumbency and extend the neck and skull in a straight line with the plane of the hard palate parallel to the x-ray film.

- Let there be no rotation along the linear axis of the patient.
- Indication is as for ventro-dorsal view.

## FRONTAL VIEW

- Position the patient in dorsal recumbency with the head flexed into a position perpendicular to the spine.
- The angle of X-ray beam or degree to which the head is flexed varies with the shape of the skull and prominence of the frontal sinuses.
- Useful for evaluating frontal sinuses and foreman magnum.

## MYELOGRAPHY

- This refers to the radiography of the spinal cord (usually after injecting a contrast medium into the subarachnoid space).
- Non-ionic contrast material e.g Iohexol 240mg/ml concern and Iopamidol 200mg/ml
- Introduction of the media into the subarachnoid space is either through the cisterna magna or in the caudal spine.
- Site of puncture closest to the suspected lesion is preferred.

## INDICATION

- Spinal Neoplasia (gains clinical significance when the pathogenic and enlarging mass compresses nervous tissues or the invasive growth of the tumour undermines the vertebral architecture and lead to pathologic fracture).
- Fracture (either due to trauma or pathologic).
- Vertebral osteomyelitis and disco-spondylitis (infection involvement of intervertebral disk, adjacent vertebral and plates & vertebrate bodies).

- **Vertebral dislocation/disk spondylitis/ luxation**
  - i) Caudal cervical spondylomyelopathy (wobbler's syndrome).
  - ii) Caudal equine syndrome
  - iii) Intervertebral disc prolapse

## TECHNIQUES

- Evaluation of the spinal radiography should be performed systematically.
- Positioning markedly affects the appearance of the vertebral bodies thus the spine requires precise positioning therefore anaesthetize the patient.
- The spine can be divided anatomically into cervical, thoracic, thoracolumbar, lumbar and sacro-coccygeal segments.

## LATERAL VIEW (Cervical Spine)

- Elevate the animal's nose slightly and support the mandible so that they are positioned parallel to the film.
- Place a radiolucent material (e.g cotton wool roll or foam sponge) under the neck at the level of C4 to C7 to prevent the mid-cervical area from sagging towards the film when the patient is in lateral recumbency.
- Lateral views of the thoracic, thoracolumbar, lumbar and sacra spine requires external patient support.
- Put a radiolucent material under the sternum to bring it up to the level of the thoracic vertebrae. This prevents the torso rotation of the ventral-most aspect of the chest coming closer to the table & film than does the dorsal portion of the chest.

# INTERPRETATION OF MYELOGRAPHIC LESIONS

Myelographic abnormalities may be divided into 3 viz:

- Intramedullary patterns
- Extramedullary patterns
- Extradural - intradural patterns.

## **Intramedullary Lesions**

- Arises within the substance of the spinal cord causing circumferential expansion and widening of the spinal cord.
- This results in a decrease width of the subarachnoid space on both lateral and ventrodorsal views:
- Causes may be spinal cord swelling due to oedema, haemorrhage or neoplasia.
- If a long segment of the spinal cord is affected (i.e. extending more than two or three vertebral bodies), the lesion is more likely due to haemorrhage or oedema rather than tumour.

## **Extramedullary- Intradural Lesions**

- Arises within the dura tube but external to the substance of spinal cord and results in widening of the cord in one view and deviation to the side of the other view.
- The mass within the dura tube is within the sub-arachnoid space or impinge upon it and may be outlined by the contrast material.
- A prolapsed intervertebral disc may penetrate the dura and produce this lesion or there may be an unusual primary or metastatic tumor in the site.

## **Extradural Lesions**

- Arises external to the dura tube and usually will produce widening of the cord on one view and displacement away from the lesion with resultant compression of the spinal cord on the opposite view.
- Most common cause of extradural lesions is a prolapsed intervertebral disc.
- Others causes are tumors arising from the vertebral body, tumor arising from the dura, neurofibromas, abscess, foreign bodies, haemorrhage, aberrant parasites and metastatic tumors.

## **COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING (CT & MRI)**

- Both methods/techniques have been used for evaluation of a wide variety of diseases affecting the skull and associated soft tissues.
- They produce cross-sectional images of the head which provides more superior information that surpasses those obtained by standard radiographic studies.
- Major limitations are availability of the equipments and the expense of the examination.
- CT is useful for tumour staging and planning of radiation therapy or surgery although the tumour could be better identified correctly on the radiograph.
- MRI produces similar information to CT scan but soft tissue changes are better defined with MRI while bony lesions are better defined with CT.
- MRI can easily identify the extent of tumour mass within the nasal cavity, presence of exudates within the frontal sinuses and the spread of the tumour to the brain.

# LECTURE II: APPLICATION OF ULTRASONOGRAPHY IN REPRODUCTION

## INTRODUCTION

- Abdominal ultrasonography is usually performed in association with radiography.
- A combination of ultrasonography and radiographic evaluation usually provides more information than either study by itself.
- Ultrasonography is based on pulse-echo principle.
- A pulse of high-frequency sound (ultrasound) is transmitted into the body which travels until it reaches a reflecting surface, at which time a portion of the ultrasound pulse (the echo) is reflected back towards the source of the pulse.
- Ultrasonographic examination reveals the size, shape, echogenicity, position and internal architecture of abdominal structures.
- It provides information about internal structures of most tissue-dense abdominal organs that cannot be obtained from the radiograph.

## INDICATION

- Evaluation of cystic and neoplastic ovaries
- Pregnancy diagnosis (both confirmation and stage/age)
- Cystic endometra
- Hyperplasia-pyometra/endometritis
- Post-partum uterine enlargement
- Hydrometra
- Uterine tumor



## **PATIENT PREPARATION FOR ULTRASOUND**

- Position the animal dorso-ventrally or lateral recumbency.
- Clip/shave the hair in very hairy patient or wet the hair coat with alcohol before applying the gel. This improves the contact between the skin and transducer.
- Choice of transducer and gain settings depends on the patient's size, organ of interest and availability of equipment.
- All organs should be evaluated in at least two planes: longitudinal and transverse; although oblique planes are also extremely useful.

## **DIAGNOSIS OF PREGNANCY AND OTHER CONDITIONS WITH ULTRASOUND**

- The normal anestrus ovary is small and hard to identify but it becomes larger and more easily identified during proestrus and oestrus.
- The ovary is normally smooth but may become irregularly shaped prior to ovulation (follicles). Some follicles responding to the follicle - stimulating hormone FSH, which are being readied for ovulation, undergo notable development.
- Follicles may be identified before ovulation as anechoic structure within the ovary.
- At Ovulation, follicles become hypo-echoic. The diameter in days just before ovulation is around 7-8mm but with some variations.
- Ovarian cysts are anechoic, vary in sizes and may be solitary or multiple.
- Ovarian tumours are hetero-echoic and may contain anechoic cystic areas.
- Pyometra can be recognized when the uterus is enlarged, thin walled and filled with echogenic fluid
- When the uterus is enlarged only slightly with a thick wall, a specific diagnosis may be

difficult. Possible conditions include endometritis, endometrial hyperplasia, hydrometra, mucometra, haematometra or even pyometra

- The anestrus uterus may be identified as a tubular structure with hypoechoic walls and a minimally hyperechoic lumen. It is identified dorsally to the urinary bladder.
- The echogenic strips of the laminar structure of the uterine wall are less notable than that associated with the alimentary tract. The dominating echogenic strips in the intestine thus facilitates its differentiation from the uterus sonographically.
- With high frequency transducer, pregnancy can be detected as early as 10 days in dogs and 4 days in cats. While most cases of pregnancy can be confirmed by 17 to 20 days gestational age (G.A), 99% accuracy can be achieved by 28 days G.A even when uncertain about the breeding date.
- The blastocyst appears as a focal slightly hyperechoic area in the uterine horn. A small central hyperechoic area may also be observed within the blastocyst.
- As the blastocyst enlarges, the uterus becomes less tubular and segmentation can be observed.
- The diameter of the gestational sac varies even among fetuses in the same litter.
- Foetal cardiac activity can be identified at 20 days in the dog and 17 days in cats
- Mineralization of the mandible, ribs, spine and skull are detectable as hyperechoic symmetric structures at approximately 30- 33 days gestational age.
- At 37 days, cardiac chambers can be identified.
- Lungs and liver have equal echo intensity by 40 days but echo intensity of the lung increases by day 43.
- By day 46 long bones and facial features are evident and intestinal motility may be

observed by day 58-63.

- By means of foetal head diameter (HD) measured across the calvarium, body diameter (BD) at the level of liver, gestational sac diameter (GSD) or crown rump length (CRL) measurements, ultrasonography can be used to assess gestational age (G.A) in bitches and queens as follows:

i) Bitches: G.A less than 40 days

$$GA (+/-3 \text{ days}) = (6x \text{ GSD}) + 20$$

$$GA (+/- 3 \text{ days}) = (3 \times \text{ CRL}) + 27$$

G.A greater than 40 days

$$G.A (+/-3 \text{ days}) = (15 \times \text{ HD}) + 20$$

$$GA (+/- 3 \text{ days}) = (7x \text{ BD}) + 29$$

$$GA (+/- 3 \text{ days}) = (6x \text{ HD}) + (3x\text{BD}) + 30$$

ii) Queens: GA greater than 40 days

$$GA (+/- 2 \text{ days}) = (25 \times \text{ HD}) + 3$$

$$GA (+/- 2 \text{ DAYS}) = (11 \times \text{ BD}) + 21$$

- 1 – 4 days post partum, the uterus is large and its contents are heteroechoic. Placentation sites may be visible as ovoid heteroechoic areas.
- Both hypoechoic and hyperechoic uterine contents are visible and the uterine wall is thick. As uterine involution progresses, the wall becomes thinner and placentation sites becomes more uniform and less distinguishable from the rest of the uterine wall.

# LECTURE III: NEOPLASTIC DISEASES OF MUSCULOSKELETIAL SYSTEM (OSTEOSARCOMA AND FIBROSARCOMA)

## INTRODUCTION

- Neoplasms are tumours or abnormal growth in which cell multiplication is uncontrolled and progressive.
- Neoplasm may be benign or malignant
- Neoplastic conditions/diseases of the musculoskeletal systems refer to tumours of bones and cartilages.
- Neoplastic diseases are common in dogs and cats
- Bone neoplasm must be diagnosed by radiographic studies (clinical and specimen radiographies) and in conjunction with gross and histopathologic examinations of tissues obtained by biopsy or at necropsy.

## OSTEOSARCOMA

- Osteosarcoma is a bone producing (i.e. osteoids) malignant tumour.
- It is the most common bone tumour in dogs and cats accounting for about 80% of all bone tumours.
- It tends to occur in large breeds of dogs: Great Dane, German shepherds, St Bernards, boxers, Irish settler, Labradors, Dobermans & Collies.
- Both male & females are about equally represented with mean age of onset being about 7.5 years & ranges between 1-15 yrs.
- Most Osteosarcoma (75%) originates in long bones and 25% arise in flat bones while the fore limbs are often more affected.

## CLINICAL SIGNS AND DIAGNOSIS

- There is rapid onset of lameness over 2 to 5 days
- Pain and localized swelling around the lesion.
- Osteosarcoma involving the vertebral column usually causes neurologic weakness associated with spinal cord compression.
- Occasionally, fever and anorexia are observed
- Epistaxis or nasal discharges is seen if nasal cavities and sinuses are involved.
- Pathologic fracture is not uncommon
- Radiography reveals solitary lesions in the bones with either osteolytic or blastic areas or both having irregular or scalloped edges with a moth-eaten pattern.
- A periosteal reaction present in about 95% of the lesions has a sunburst appearance
- The cortex is eroded and margin is poorly demarcated while there are widened bone contour throughout the cancellous portion of the epiphysis. These lesions could extend into metaphysis or diaphysis.
- Matrix pattern exhibits various degree of mineralization from solid or cloud-like to an ill-defined ivory density.
- Tumour growth rate is usually rapid with large amount of soft tissue swelling
- Pulmonary metastases may not easily be recognized in the early stages of the tumour
- Diagnosis is confirmed by biopsy of the lesion. And care should be taken to sample several sites, specifically the margins.
- In lieu of biopsy, clinical signs, age, breed, lesion location and radiography may be used to make tentative diagnosis.

## MANAGEMENT

- The incidence of metastasis of osteosarcoma has been reported to be from 20% to 59% in dogs and 7% in cats.
- Metastasis takes place primarily through the circulation and rarely the lymph nodes and common sites in dogs are lungs, kidneys, bones, liver, heart, spleen and adrenals.
- Thus aggressive chemotherapy (with drugs like Vincristine sulfate, Methotrexate, Doxorubicin HCL, Ciplastin etc.) followed by en bloc resection of the tumour is the treatment of choice.
- Only 10%-15% of dogs survive longer than 9 months following diagnosis and amputation.
- Amputation of involved limb will alleviate pain but that does not necessarily prolong the life of pet unless when coupled with other modalities like chemotherapy, immunotherapy and radiotherapy.
- The prognosis is very poor.

## FIBROSARCOMA

- Fibrosarcoma arises from malignant fibrous connective tissue elements (cells) that produce a collagenous matrix but no neoplastic cartilage or bone.
- Fibrosarcoma of bone is rare in dogs. It arises primarily in the metaphyseal area of the long bones. Common in femoral metaphysis.
- It occur mostly in medium to large breed, aged male dogs with approximately 60% of tumour associated with bones of the skull (maxilla, mandible, frontal & nasal bones) and

30% associated with invading bones of extremities.

## CLINICAL SIGNS, DIAGNOSIS AND MANAGEMENT

- Clinical signs are often masked for a period of time when the tumour is growing under a sizable muscle mass.
- There is lameness and soft tissue swelling around the affected limb or area.
- Gross examination may reveal an homogenous pinkish white soft tissue that has destroyed the underlying bones
- Radiograph shows soft tissue swelling invading adjacent bones and causing osteolytic reaction (i.e. erosion) of the underlying bones.
- Radiography is not likely to differentiate between the primary and metastatic tumour of the bone, although metastasis of fibrosarcoma is rare.
- There is early periosteal proliferation in the disease course.
- Treatment requires surgical excision of tumour mass followed by local radiation therapy
- Prognosis is poor or guarded. Although fibrosarcoma is slow in growing, it will recur and can result in pulmonary metastasis as long as 1 year following surgery.