Diagnostic and Treatment of Joint Diseases of Small Animals

- Updates
- Clinical Management
Introduction

- Increase of the frequency of joint diseases in dogs and cats due to:
  - Increase of life expectancy
  - More medium - large breeds
  - More obese animals
  - Increase of animal of predisposed breeds

- Difficult to accurately diagnose
Structure of Joint

Subchondral plate: « support »

Joint Capsule: ligament-like structure + synovial membrane

Synovial fluid feeds the cartilage + lubrication

Articular Cartilage « shock absorption »
The Healthy Cartilage

- **Chondrocytes:**
  - synthesis of proteoglycans
  - secretion of catabolic enzymes
  
  => regulation system:

  **balance** synthesis / degradation

- **Matrix:** shock absorption
  - 80% water
  - 12% collagen
  - 2% proteoglycans
  - other substances

Physiology of Cartilage

- Not irrigated by blood vessels
- \( \Rightarrow \) specific nutrition system: « pumping »

**COMPRESSION**
- rejection of waste in the synovial fluid

**DEPRESSION**
- aspiration of the synovial fluid

**WASTE**

**NUTRIMENTS**
Inflammatory Joint Diseases

- Very numerous:
  more than 300 are listed in the literature

- Varied causes:
  - immune mediated factors
  - microbial infection
  - secondary effect of trauma
Inflammatory Joint Diseases

- Immune mediated polyarthritis

Picture: Masahiro Okumura
Non-Inflammatory Joint Diseases

- Degeneration of joint structures, like cartilage:
  - OSTEOARTHRITIS
  - OSTEOARTICULAR DYSPLASIA
General Pathogenic Process

In case of joint disease:

- Modification of cartilage matrix homeostasis
  
  $\Rightarrow$ \textit{lowering of viscoelasticity}
  
  $\Rightarrow$ \textit{increase of frictions}

- This leads to degenerative disease
  
  = osteoarthritis (OA) = degenerative joint disease (DJD)
OA Pathogenic Process: Phase 1

- **Over-pressure**
  - on normal cartilage:
    - luxation
    - unstability of the joint
    - dysplasia
    - overweight

- OR **Normal pressure**
  - on un-normal cartilage
    - tumoral process
    - old cartilage
    - genetic malformation
    - nutritionnal troubles
OA Pathogenic Process: Phase 2

- Hyperpressure
  - Activation of chondrocytes
    - Decrease of synthesis
    - Increase of Metalloproteases
      - Destruction of cartilage Matrix
    - Release of cartilage fragments
  - PgL2
    - Inflammation
      - Pain
OA Pathogenic Process: Phase 3

Hyperpressure

Activation of chondrocytes

Increase of Metalloproteases

Destruction of cartilage Matrix

Release of cartilage fragments

Inflammation

PAIN

Synthesis of proteases

Activation of synoviocytes

IL 1 beta

IL 1 beta

IL6

TNF alpha

PgE2

+macrophages
OA Pathogenic Process: Results

- Fibrosis of the capsule
- Osteophytes
- Bone remodelling

Biochemical and Mechanical Vicious Circle
General Physical Examination

- **Interview of the owner:**
  - Sudden / slow onset of the disease?
  - Date of apparition and evolution, cyclic or permanent?
  - General mobility of the animal + specific motion of the legs?

- **Demeanour**

- **Examination of the Gait**

- **Neurological tests** (to exclude neurological etiology)
Examination of Lameness

- Focus on the attitude of the legs
- Animal walking toward you / away from you

- Permanent / intermittent lameness?

- Strides of each foot?

- Movements of joint under loading?
Orthopaedic Evaluation (1)

- Animal standing still:
  - Posture ?
  - Muscle atrophy ?
  - Muscular reaction ?
  - Pain along the spine, at the neck or the back ?
Orthopaedic Evaluation (2)

- Palpation (1):
  - Identify painful bones, ligaments, tendons
  - Abnormalities? Displacements?
  - Joints with fibrosis?
  - Pain?
  - Instability?
Orthopaedic Evaluation (3)

- Palpation (2):
  - Restriction in the motion of any leg / joint?
  - Crepitus?
  - Condition of soft tissues around joint?
  - Swelling?
Orthopaedic Evaluation (4)

- Palpation of the joint of the **elbow**

*Picture: Masahiro Okumura*
Orthopaedic Evaluation (5)

- Palpation of the joint of the **elbow**

*Picture: Masahiro Okumura.*
Orthopaedic Evaluation (6)

- Palpation of the joint of the hip
Orthopaedic Evaluation (7)

- Biodynamic tests:
  - To carry out on a sedated / anesthesied animal
  - To evaluate stability of the joint
    - Cranial drawer sign
    - Ortolani sign
    - Barden sign
Orthopaedic Evaluation (8)

- Biodynamic tests:
  - Cranial drawer sign
  - anterior cruciate ligament rupture of the knee joint

Orthopaedic Evaluation (9)

- Biodynamic tests:
  
  - Ortolani sign

  stability of hip joint having dysplasia

Diagnostic Imaging

- Changes in joint structure

Diagnostic Imaging: X-Ray

- Time gap between the beginning of the disease and the stage when the lesions are detectable by radiography

- All lesions may not be all related to the present disease
Diagnostic Imaging: X-Ray

- OA of elbow joint
  - Fragmented medial coronoid process

- Remodeling of the subchondral bone

Diagnostic Imaging: X-Ray

- OA of hip joint


Location of lesion detected in the radiogram
Diagnostic Imaging: X-Ray

- OA of knee joint

Diagnostic Imaging: Arthroscopy

- **Interest:**
  - direct observation of ligaments, tendons, synovial membrane, articular cartilage
  - biopsy of synovial membrane
  - excising, removing fragments
Diagnostic Imaging: Arthroscopy

- Arthroscopy of the Elbow

*Picture: Masahiro Okumura...*
Diagnostic Imaging: Arthroscopy

- Fragmented coronoid process of ulna

Diagnostic Imaging: Arthroscopy

- Fragmented coronoid process of ulna

  => Inflammation of the synovial membrane

Biceps tendon in the shoulder joint =>
Diagnostic Imaging: Tomography

- **X-Ray CT:**
  - excellent for detecting calcification
- **X-Ray CT 3D**
- **MRI:**
  - can show images of soft tissues like cartilage and tendon
- **Limits:**
  - cost
  - deep sedation / anesthesia required
  - resolution of the images obtained
Diagnostic Imaging: Tomography

- X-Ray CT:

  Fragmented coronoid process of ulna

Picture: Masahiro Okumura
Diagnostic Imaging: Tomography

- X-Ray CT 3D:

  Fragmented coronoid process of ulna

![Image of X-Ray CT 3D showing fragmented coronoid process of ulna](Picture: Masahiro Okumura..)
Diagnostic Imaging: Tomography

- Ultrasonography:
  - useful in detection of lesions of biceps and ligaments
  - not a practical examination for joints because of a very small acoustic window in this particular area
Tests on Synovial Fluid

- Interesting to detect and evaluate:
  - infections
  - neoplasia
  - inflammation

- Puncturing:
  - a perfect aseptia is required
  - 22-25G needle
  - 2ml syringe
Tests on Synovial Fluid

- Elements to analyse:
  - amount of fluid
  - appearance
  - cytological analysis
    - presence of PNN => inflammation
    - PNN morphology: immune disease vs. infection
  - protein content
  - bacteriological culture test
Tests on Synovial Fluid

- Amount of fluid
- Appearance
Treatment Strategy

- Conservative therapy
  - remove the cause of the disease
  - control pain and inflammation
  - protect the damaged cartilage

  => a Combined Drug Therapy is needed

- Surgical treatment
  - often last resort
  - when the control of pain becomes impossible
Conservative Therapy

- Supportive treatment:
  - Mild exercise is needed every day:
    - to maintain range of motion of joint
    - to strengthen soft tissues around the joint
    - to enhance the metabolic activity of cartilage
  - Weight control
    - to decrease the over-pressure on the cartilage
Conservative Therapy

- Purposes of drug therapy:
  - Control of **Pain**, on short and long term for animal welfare & to support cartilage physiology
  - Control of **Inflammation**
  - Modify the cartilage **Matrix Metabolism**

- Long term treatment => drugs with **minimal side effects** are required
Conservative Therapy: Drugs (1)

- **Available drugs:**
  - **NSAIDs:** oral & injectable
  - **DMOAs:** oral & injectable
    (Disease-modifying osteoarthritis agents)
  - **Steroids:** oral & injectable
  - **Morphinics:** oral & injectable
  - **Local anesthetics**
Conservative Therapy: Drugs (2)

- All drugs are complementary:

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Reduction of Pain</th>
<th>Reduction of Inflammation</th>
<th>Protection of cartilage</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSAIDs</td>
<td>++, short term</td>
<td>++, short term</td>
<td>0/+</td>
<td>+</td>
</tr>
<tr>
<td>DMOAs</td>
<td>++, long term</td>
<td>++, long term</td>
<td>+++</td>
<td>0</td>
</tr>
<tr>
<td>Steroids</td>
<td>++, temporary</td>
<td>+++</td>
<td>- - -</td>
<td>++</td>
</tr>
<tr>
<td>Morphinics</td>
<td>++</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Local anesthetics</td>
<td>++++, short action</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Conservative Therapy: Drugs (3)

- IL 1 beta
- IL6
- TNF alpha

**Hyperpressure**
- Increase of Metalloproteases
- Release of cartilage fragments
- Inflammation
  - Activation of chondrocytes (IL 1 beta)
  - Activation of synoviocytes
  - Destruction of cartilage matrix
  - Synthesis of proteases
  - PAIN

**CS**
- Chondroitin Sulfate (DMOA)
- NSAID

**Steroids**
- Local Anesth.

**Morphinics**
+ macrophages

**CS = Chondroitin Sulfate (DMOA)**
Conservative Therapy: Drugs (4)

Drug Strategy:

- **Common case:** NSAI D (short-medium term) + DMOA (from the beginning - long term effect)

- If severe inflammation: + **Steroids** (short term)

- If severe pain still present after NSAI Ds: + **Local anesthetics** + **Morphinics**
### Conservative Therapy: Drugs (5)

**Available DMOAs:**

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Pro</th>
<th>Cons</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Chondroitine Sulfate | - Anti-inflammatory + chondroprotective effect<br>  
                     | - The predominant proteoglycan in the matrix<br>  
                     | - Carry-over effect                                                  | - Needs 2 weeks to show effects by oral route<br>  
                     |                                                                   | - Highly degradated in the digestive tract                       | - As soon as the beginning of the treatment, in combination with pain killers<br>  
                     |                                                                   |                                                                   | - Long term management                                          |
| Hyaluronic acid  | - Lubrication role when injected in the joint                        | - Difficult management of injections on the long term             | - Injection at the beginning of the treatment         |
| Glucosamine      | - Lubrication role when injected in the joint<br>  
                     | - Resistant to digestive enzymes                                    | - More structural than anti-inflammatory effect<br>  
                     |                                                                   | - No direct study in small animals                                | - Idem CS<br>  
                     |                                                                   |                                                                   | - May be completed with NSAIDs on the long term                 |
Surgical Treatment

- **Arthrodesis**
  - common procedure

- **Replacement arthroplasty**
  - use of artificial materials
    - =>use for the hip joint of large dogs only

- **Excisional arthroplasty**
  - Easier, but functions reduced after surgery
    - (except for the hip)
Surgical Treatment: Arthrodesis

Articular disintegration

Picture: Masahiro Okumura...
Conclusion

- Joint diseases concern welfare and quality of life
- Easy and objective methods for diagnosis
- Treat the underlying diseases
- Restore joint function
- Combined therapy is needed for treatment, in addition to animal welfare & quality of life