2. CLINICAL APPROACH

- Dramatic cases are rare
- Unexplained vomiting
- Blood in the vomitus
- Sudden death

Gastric ulcers in racing sled dogs

- Studies conducted during Iditarod 2000 and 2001
  [Davis, Oklahoma State University]

  Prevalence of gastric ulceration, erosion, hemorrhage or dropped dogs

  35 p100 in 2000
  48.5 p100 in 2001

- Study on the relation between duration of exercise and gastric diseases
  [Davis, Oklahoma State University]

  42 dogs randomly chosen for examination after 1 to 5 consecutive days of running 100 miles/day.

  Endurance exercise increases intestinal protein loss
  Substantial exercise causes gastric alterations
Study conducted on beagles
[Bersenas, Ontario Veterinary College]
Ranitidine [Zantac]
Famotidine [Pepcid]
Pantoprazole [Protonox]
Omeprazole [Mopral]

Study on Racing alaskan huskies
[Williamson, Oklahoma State University]
Famotidine [Pepcid] is effective in reducing the severity of exercise-induced gastric diseases
22 mg/dog/pers/24 hours

Stool frequency, volume, consistency, color highly variable
Extracellular dehydration (electrolytes losses)
Cachexia (nutrient losses)
Anorexia
± vomiting, ± hyperthermia
± tenesmus
± melana and/or hematochezia
**EXERCISE ENTERAL ISCHEMIA**

- **EXERCISE**
  - MUSCLES
- **BLOOD FLOW**
- **DIGESTIVE TRACT**
  - DIGESTIVE MUCOSA DAMAGES
  - SLOWED MUCUS TURN OVER
  - DECREASE IN WATER REABSORPTION
  - EROSION OF INTESTINAL BLOOD VESSELS
  - OSMOTIC DIARRHEA
  - ± FRESH BLOOD
  - SECONDARY ISCHEMIC COLITIS

**OTHER FACTORS INVOLVED IN “STRESS” DIARRHEA**

- “CAECAL SLAP SYNDROM”
  - Microtraumas of the mucosa
  - Too much iron in the diet
- “RUNNER’S TROT”
  - Uncontrolled spasmodic contractions of colonic muscles
  - Soreness, tenesmus and bloody diarrhea
- INDUCED EXTRACELLULAR DEHYDRATION
Stress Diarrhea Dehydration Syndrome

W ∅ C
Stress

Anorexia

Vicious circle

Diarrhea

Extracellular Dehydration

1 / Beet pulp
facilitate transit and formation of moulded stools

2 / Zeolite
Protects mucosa ("intestinal bandage")

3 / FOS / MOS
Stimulate bacterial flora, nourish mucosa

4 / Fish oil (EPA/DHA)
anti-inflammatory role

Nutritional prevention of stress diarrhea
Clays: properties of Zeolite and Smectite

A great surface of exchange

Surface of exchange corresponding to 1 g of zeolite: hundreds of m²/g

Very high porosity

Absorption of excess water in the intestine (up to 50 % of its own volume)

Mannan-Oligo-Saccharides (MOS)

Non fermentable fibres

- Double action at the intestinal level:
  1) Lure effect / pathogenous bacteria
  2) « Booster » effect upon local immunity:
     increased production of IgA (O’Carra 1996, 1997)

Surface polysaccharides

Lectins

MOS
**FOS: regulation effect upon bacterial flora**

F.O.S.
- Growth of bifidobacteria & lactobacillus
- Production of lactate, acetate, propionate, butyrate
- Acidification of the intestinal content
- Limits proliferation of pathogenous bacteria (Clostridia, E. Coli, Salmonella…)

= Barrier effect

**Mucilages: Psyllium**

Soluble fibres forming a viscous gel with the water contained in the intestinal tract.
- Can retain 10 times their water volume

Slow down gastric emptying
Reduction of post-prandial glycaemia peak

Increase viscosity of faeces and facilitate their elimination
- Psyllium is suggested in case of constipation in Man
Oxygen: Vital but Dangerous...
about oxidative stress
in the working dog

Nutritional prevention of oxidative stress

High intensity exercise
muscle hypoxia
muscle ischemia-reperfusion

↑↑↑ Free radicals
antioxidants

Destruction of cell membranes
Lesions ————> death

Training Nutrition
Training Nutrition Genetics?
Early diagnosis
Free radical production O₂⁻, H₂O₂, OH.
Antioxidants Vit E, Vit C, Glutathion, SOD...
Oxidative stress
Physical exercise
Length
Intensity
VO₂ max
Altitude
Temperature
EXCESS
INFLAMMATION
FAILURE
LESIONS OF MUSCLE CELLS

Research conducted with U.M.E.S. and Royal Canin
Prevention of stress consequences

- ↑↑ Proteins in the diet [Prot/Cal Ratio > 70]
  - Endocrinology of stress
  - Prevention of « Sport Anemia »

- ↑↑ Energy transfers [L. carnitine, SCFA]
  - ↑ VO₂ max
  - ↓ lactate production

- ↑↑ Muscle oxigenation [Omega 3 fatty acids] ; ↓↓ Inflammation

- ↑↑ Oxidative Stress [Vitamin E, C, polyphenols, SOD,...]
  - Prevention of related pathologies
  - ↑ length of the dog’s carrier
Scientific expedition
« Chien des cimes »
Licancabur Volcano-Chile

Effects of acute altitude hypoxia on working dogs
Clinical and behavioural modifications induced
Interest of a nutritional antioxidant prevention versus consequences of acute mountain disease in the dog
Licancabur; Chile; 6000 meters

Members of the expedition

- Brigade de Sapeurs Pompiers de Paris
- Carabineros de Chile
- Unité de Médecine de l'Elevage et du Sport
- Royal Canin Research Center
- Logistics and media crew

10 dogs
20 people

Licancabur; Chile; 6000 meters

Chronology and logistic

Paris (France) → Santiago (Chile) → Basecamp (Bolivia) → San Pedro de Atacama → Basecamp (Bolivia) → Inca temples ruins
Licancabur; Chile; 6000 meters

Scientific protocols

Group 1: 35/20 dry food

Group 2: 35/20 dry food +
  - Vitamin E (500 mg/day)
  - Vitamin C (500 mg/day)
  - Omega 3 (300 mg/day)
Licancabur ; Chile ; 6000 meters

Biological and nutritional consequences of work at high altitude in search and rescue dogs:
The scientific expedition Chiens des Cimes-Licancabur

Group 2 >> Group 1

- Plasma vitamin E ↑
- Peroxidation Resistance Index ↑
- Oxygen transfer to working cells ↑
- Clinical problems ↓↓
  - stress diarrhea
  - muscle stiffness and rhabdomyolysis
  - acute pulmonary oedema
« Chiens des cimes Mont-Blanc »
4500 m Chamonix (France)

Level 0
Drop
Search…
...and 20mn exercise - 4000m
Post effort test 4000m
Mont-Blanc 2004: Scientific protocol

- **Antioxidants**
  - Blood samples
  - ECG
  - Oximetry
  - Clinical Exams

- **Placebo**
  - Treatment csq

**Levels**
- Level 0 [April]
- Level 3500 m [March]

**Parameters**
- Oxidation parameters
- Heart function
- Hemoglobin saturation
- Acute Mountain Disease
Heart frequency

<table>
<thead>
<tr>
<th>Heart frequency</th>
<th>Heart frequency</th>
<th>Heart frequency</th>
<th>Heart frequency</th>
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<tbody>
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<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
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<td>170</td>
<td>180</td>
<td>190</td>
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</tr>
</tbody>
</table>

Mont-Blanc 2004: Scientific protocol

Mont-Blanc 2004: Results

ECG

Sinus Respiratory Arrhythmia
Physiological in well trained working dogs

Dog: Tarun
ECG

ST sub segment:
Baseline / ST segment
=> Witness of myocardial hypoxia
-0.2 mV < NORMAL < + 0.15 mV

Hard work in altitude
Treated group: OK

Dog: Patcho

---

ECG

ST sub segment:
Baseline / ST segment
=> Witness of myocardial hypoxia
-0.2 mV < NORMAL < + 0.15 mV

Hard work in altitude
Placebo group: myocardial hypoxia

-0.4 mV in baseline

Dog: Malouk
Mont-Blanc 2004 : Results

ECG

% of dogs without myocardial hypoxia signs in altitude

![Bar chart showing percentage of dogs without myocardial hypoxia signs at different altitudes and rest conditions.]

Mont-Blanc 2004 : Scientific protocol

Oximetry

Results

![Bar chart showing saturation (%) at T1 and T2 with best saturation in acute altitude of treated dogs and best oxygenation post effort.]

Sea level

3500m altitude

Rest

Work

Sea level +24h

Rest

Treated
Placebo

91.4

86.6

90.8

81.4

70

75

80

85

90

95

100

T1

Best saturation in acute altitude of treated dogs

T2

Best oxygenation post effort
Plasma Vitamin E levels
Working tests altitude 0 and altitude 3500

Vitamin E (µmol/l)

<table>
<thead>
<tr>
<th></th>
<th>Placebo</th>
<th>Propentofylline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>43.5</td>
<td>44.1</td>
</tr>
<tr>
<td>Post-work</td>
<td>46.9</td>
<td>43.5</td>
</tr>
<tr>
<td>24 hours</td>
<td>44.4</td>
<td>43.4</td>
</tr>
</tbody>
</table>

Evolution of TPAO (Total Plasma Anti-Oxidant)

TPAO (mmol/l)

<table>
<thead>
<tr>
<th></th>
<th>Placebo</th>
<th>Propentofylline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest</td>
<td>0.78</td>
<td>0.79</td>
</tr>
<tr>
<td>Post-work</td>
<td>0.78</td>
<td>0.82</td>
</tr>
<tr>
<td>24 hours</td>
<td>0.7</td>
<td>0.77</td>
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Working tests altitude 0 and altitude 3500
Evolution of plasma MDA (Malondialdehyde)
Working tests altitude 0 and altitude 3500

**Normoxia**

<table>
<thead>
<tr>
<th></th>
<th>Placebo</th>
<th>Propentofylline</th>
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</thead>
<tbody>
<tr>
<td>MDA (µmol/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NORMOXIA</td>
<td>6.5</td>
<td>5.39</td>
</tr>
<tr>
<td></td>
<td>5.03</td>
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**Hypoxia**

<table>
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<th>Propentofylline</th>
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</thead>
<tbody>
<tr>
<td>MDA (µmol/l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HYPOXIA</td>
<td>5.46</td>
<td>7.12</td>
</tr>
<tr>
<td></td>
<td>6.75</td>
<td>6.55</td>
</tr>
</tbody>
</table>
Global cellular antioxidation concept

Vitamins (E,C)

Polyphenols

Enzymes (SOD)

lutein

DIGESTIVE TRACT
SPORT ANEMIA
MUSCLE-TENDONS PROBLEMS
STRESS FRACTURES
CHRONIC JOINT PROBLEMS
 RESPIRATORY FRAGILITY
Sensitivity to pneumania
« Ski-asthma » Like Syndrom

SUDDEN DEATH SYNDROM
End of racing season

Hemoglobin (g/dl)

32 to 40% PROTEINS / MS

26 to 28% PROTEINS / MS

[Kronfeld, 1988]

End of racing season

Time (weeks)
### Effect of protein intake during training on biochemical and performance variables in sled dogs

<table>
<thead>
<tr>
<th>Proteins [% of ME] (% in a 4500 kcal ME/kg dry food)</th>
<th>18  (20)</th>
<th>23  (26)</th>
<th>29  (33)</th>
<th>35  (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit (p100)</td>
<td>46</td>
<td>0.1</td>
<td>48</td>
<td>2</td>
</tr>
<tr>
<td>VO2max (ml/min/kg)</td>
<td>128 ± 80</td>
<td>174 ± 12</td>
<td>180 ± 12</td>
<td>174 ± 12</td>
</tr>
<tr>
<td>Muscle problems on dogs</td>
<td>8/8</td>
<td>1/8</td>
<td>0/8</td>
<td>0/8</td>
</tr>
</tbody>
</table>

- **PROTEINS**
  - Increased structures turnover
  - Increased demand for essential amino-acid [peptidic hormones]
  - Long term stress impact
  - Glucogenic amino-acids
Low absorption of water and electrolytes
Poor digestion and absorption of nutrients
Modification in gastro-intestinal transit time
Excessive bacterial fermentation
High intestinal and colon permeability

Biologic value of proteins
Balance of essential amino-acids
STRESS RELATED MEDICAL PROBLEMS IN WORKING DOGS

DIGESTIVE TRACT
- Gastric ulcers
- Stress diarrhea

SPORT ANEMIA

MUSCLE-TENDONS PROBLEMS

STRESS FRACTURES

CHRONIC JOINT PROBLEMS

RESPIRATORY FRAGILITY
- Sensitivity to pneumania
- "Ski-asthma" Like Syndrom

SUDDEN DEATH SYNDROM

Pathology of muscles and tendons

Cramp
- Rhabdomyolysis consequence

Rupture
- Muscle rupture

Inflammation
- Precise diagnosis

No Lesion

Lesion
- Tendon rupture