OZONOTHERAPY IN EQUINE SEPTIC ARTHRITIS

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AAO CONGRESS OZONOTHERAPY
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INTRODUCTION

The horse industry is of great importance in Latin American countries for its distinguished livestock conditions, enjoying unique natural and climatic advantages.

For these reasons the region produces EQUINES, and the genetic improved in recent years offers the possibility to export animals all over the world, and it is a source of work and foreign currency for producer countries.

The need of an optimum & functional musculoskeletal system gives reason to this research.
1- **Diartrrosis**: These joints have a great mobility and are composed of two bones that are joined by the collateral ligaments and a articular capsule. They possess a synovial cavity with fluid and articular cartilage that it coats the long bones subchondral bone. They have a villus synovial fluid-producing synovial membrane. The synovial fluid is composed by water, glicosaminoglycanes, proteins, hyaluronic acid.
Other types of joints do not have the same Anatomy, being absent cavity joint and the liquid joint. In addition articular cartilage and its relationship to the subchondral bone is different.

2- Sinartrosis
(fibrous joint)

3- Amphiartroses
(cartilage joint)
DEVELOPMENT OF JOINT DISEASE

INFECTIOUS ARTHRITIS

The joints may suffer infections very commonly in horses. The gateways of the bacteria are:

- Traumatic wounds that included the capsula
- Hematogenous infection
- Regional cellulitis near joint
- Iatrogenic infection (artrothomy, inyections, joint aspiration)

Whatever the cause is, it is an medical "emergency".

"The horse is an animal that depends on its locomotive to provide its utility"
Example Hematogenous DIARTROSIS
BACTERIAS THAT PRODUCE SEPTIC ARTHRITIS

- Streptococcus sp
- Salmonella sp
- Escherischia coli
- Stafilococcus aureus
- Pseudomona aeruginosa
- Klebsiella sp
- Corinebacterium equi

LABORATORY DIAGNOSIS
Commonly they face SEVERAL difficulties for bacterial growth (in vitro)
THE SYNOVIAL FLUID CONTAINS INHIBITORY FACTORS WHO “IN VITRO” GENERATE FALSE NEGATIVE IN THE LABORATORY CULTURE.
ANTIBIOGRAM: specific antibiotic takes 48-72 hours to give results

BACTERICIDAL TREATMENT
Possibility of use within the joint, BUT several antibiotics are IRRITANT in the joint.
As FALSE NEGATIVES, you chose the ANTIBIOTIC by its spectrum and articular tolerance.

LABORATORY INDIRECT DIAGNOSE:
- SYNOVIAL WHITE CELLS NUMBER (neutrophils)
- SYNOVIAL TOTAL PROTEINS
- VISCOCITY of synovial fluid
SYNOVIAL FLUID ANALYSIS

MACROSCOPIC and MICROSCOPIC ASPECT
TIME OF COAGULATION
Culture & antibiogram
Measuring of leucocytes and total proteins
CLINIC DIAGNOSIS : TWO STAGE ACUTE CRONIC

- **NEONATES**: frecuent polyarthitis
  - akward lameness.
  - pain recumbency.
  - joint inflammation
  Fails in passive inmunity.

SIGNOLOGY : HUGE PAIN AND LOCAL DEFORMATION

- **ADULTS**: it is observed great lameness (3rd level) in acute stage that could be related or not to a local wound.

Big joint deformation due to intraarticular increase of synovial pressure.
IMAGES OF DIAGNOSIS

ECHOGRAPHY: ACUTE STAGE
Recognizes changes in echogenicity of the synovial liquid, fibrin, pieces of cartilage, articular cartilage thickness.

RADIOLOGY: SUBACUTE AND CRONIC STAGES
Does not recognize early changes.
It recognizes areas of osteomyelitis which spread towards the joint.

IN CRONIC STAGE: BONE OSTEOFITOSIS & ANCYLOSIS
EXAMPLE OF CRONIC BONE CHANGES

[Images of bone changes and diagrams related to bone pathology]
SECONDARY CHANGES

CRONIC STAGE
Installed after several days or months and when they appear next to them include chronic changes in the synovial and deterioration of the articular cartilage.
4. MEDICAL CONVENTIONAL TREATMENT: time wasting

- From 5 to 20 days in ACUTE cases
- indefinite in CRONIC cases

- **Sistemic Antibiotic therapy:** PENICILLIN, TETRACYCLINES, SULFAS, CEPHALOSPORINS, AMINOGLYCOSIDES

- **Articular lavage:** STERILES SOLUTIONS Ringer; electrolític bal.

- **Antibiotic local therapy:** GENTAMICINA, VANCOMICINA, AMICACINA
  su PH should be neutral to NOT irritate the joint.

It is intensive (daily), expensive inputs, long, and art of RIGOROUS need of ASCEPCIA in the articular lavage.
SOMETIMES CHRONIC INFECTIONS DO NOT RESPONSE.
NEW TREATMENT

CONVENTIONAL TREATMENT VERSUS ARTICULAR OZONOTHERAPIE
MATERIALS and METHODS

OZONE GENERATOR MACHINE (ozone generator of medical concentrations)
Silicon tubes
BLOOD TRANSFUSION BAGS
OXIGEN (99.5% purity)
Sterile disposable material and sterile lingerie
Destilated water (miliQ)
TERAPEUTIC AGENT

- **GASEOUS OZONE**: CC 20 a 30 ug/ml
  - Volume 20 a 60 ml in syringe

- **OZONIZED BIDESTILATED WATER**:
  - O3 Generator: emission 1,5 gr/hour
  - Bubbling time: 5 minutes
  - Volume of distilled water: 1 litre

SATURATION DE O3 IN DESTILATED WATER
PROCEDURES

THREE TYPES OF TREATMENTS

- TYPE A
- TYPE B
- TYPE C
PROCEDURES  TYPE A treatment

- DIRECT OZONE APPLICATION:
  This procedure is used in joints with sepsis, acute and initial, showing great tolerance and effectiveness, still need to repeat the application every 24 hours for 5 days.
  Ozone concentrations are inside of the therapeutic limits being decreasing from the first to the fifth application (between 15 and 30 ug/ml) the volume of gas to be applied varies from 10 to 30 cc.

Combined with SYSTEMIC OZONE THERAPY
PROCEDURES TYPE B treatment

- CONVENTIONAL ARTICULAR LAVAJE with RINGER solution or electrolytic balance solution, doing a flushing with 1 litre of fluid, with entry and exit of the joint.

- DIRECT OZONE intra-articular in high concentrations, to a variable volume according to the size joint (between 10 and 30 ml).

- OZONE Mesotherapy regional periarticular subcutaneous ozone.

- Combined with SYSTEMIC OZONE THERAPY
PROCEDURES- *TYPE C* treatment

- APPLICATION of ozone in solution: Is Ozonate the fluid in this case DISTILLED water quality milliQ at 0.316 ppm of ozone concentration, to be used as a therapeutic agent to inject it into the joint affected by way of LAVAJE (entry and exit) joint, at the rate of 1 litre.

- DIRECT OZONE intra-articular at low concentration (15 ug/ml), after the wash.

- Combined with SYSTEMIC OZONE THERAPY
MECHANISM OF ACTION OF TREATMENT

GERMICIDE ACTION: the bacterias die due to acute OXIDATION that causes ozone on them. They are PROKARIOTES, so as they do not have nucleous, the reactive species (O3) can act directly to the DNA level.

In Eukariote cells, it is known that ozone response happens in the mitocondria, and it does not reach the DNA, which is protected by the nuclear membrane, as in mammals cells.

ANTIINFLAMATORY ACTION AND ARTICULAR TISSUE BENEFITS:
The LOPs and ROS produced by the action of O3 in the tissues, will give place to reduce prostaglandin and improve altered oxidative stress of all joint components, from synovial cells up to the cartilage.
CASOS CLINICOS

ADULTO

MALE – ELBOW ART. WOUND (40 days old) (DUENDE)

DIAGNOSIS: FISTULA ARTICULAR – SEPTIC ARTHITIS – OSTEOMIELITIS
LAMENESS 3rd. GRADE (4/5)

LABORATORY:

TREATMENT: TIPO B, consisting of 4 lavages, Ozono directo IA y infiltración SC

TREATMENT TIME EVOLUTION: 20 days improve. Wound closed
CLINICAL CASES

ADULT

MALE 19 years old (POROTO)
Evolution TIME at the beginning: 30 Days

DIAGNOSIS: TARSUS Septic Arthritis
Hematogenous disemination.
Lameness 4th grade (4/5)

LABORATORY : *Pseudomonas aeruginosa*

ANTIBIOTIC resistance

300000 LEUCOCITOS = PURULENT SYN FLUID
POROTO
(HEMATOGENOUS)

TREATMENT:
1- First use *Tipo A*, with partial clinical improvement but no case resolution.

2- Second use *Tipo B*, partial clinical improvement but no case resolution.

*Controls: White Cell count and synovial Proteins*

**PRESENSE OF BIOFILM**

3-Trird use *Tipo C*, resolve the case
White cell count reduction, Synovial fluid improvement (viscosity = hialurónico),

**TOTAL RESOLUTION**

TREATMENT TIME EVOLUTION: 25 DAYS
CLINICAL CASES  (Quimera)

FOAL

Septic Poliarthritis in left TARSUS, COFFIN JOINT, left STIFLE

Evolution TIME at the beginning: 20 Days
TREATMENT *Tipo B*: - Art. Lavaje sterile solutions
- Direct OZONE IA – Mesoterapia SC

General Anestesia

ALWAYS WITH SYSTEMIC ATHM AND I Rectal INSUFLATION
CLINICAL CASES (Intuitiva)

FOAL

Septic Poliarthritis of left TARSUS, and left STIFLE joint ACUTE, bone femoral tróclea septic cyst detected.

TREATMENT: *TIPE C*, case resolution

First 4 applications every 48 hours.
Then weekly O3 direct.

CONTROLS: normal synovial fluid

post mortem examination: subcondral BONE CYST
CLINICAL CASES (Buchi Pascal)

**ADULT**

**MALE 15 years old CRONIC INFECTION**

Infection POST INFILTRATION Art. IFDistal (coffin joint)

Clinic Diagnosis: Lameness de 3rd grade . Pulse + (positive).
Articular Synovitis . PAIN

**TREATMENT :**

*Tipo C . Ozonized Bidestil H₂O lavaje*

Ozono directo IA and SC

**RESULTS :** third day :

90 % of improvement

**TREATMENT TIME EVOLUTION : 10 DAYS**
EFFECTS OF THE OZONOTHERAPY

Before initiating therapy  4th day of treatment
## RESULTS

### Distribution according to age

<table>
<thead>
<tr>
<th>age</th>
<th>Number of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEONATES (&gt;40dias)</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>FOALS (40 días a 1,5 años)</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>ADULTS</td>
<td>6</td>
<td>42</td>
</tr>
</tbody>
</table>

### Distribution according to mechanism cause

<table>
<thead>
<tr>
<th>Mechanism cause</th>
<th>Number of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematogenous dissemination</td>
<td>8</td>
<td>68</td>
</tr>
<tr>
<td>articular wounds</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Infiltration and inyection (complication)</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
## RESULTS

<table>
<thead>
<tr>
<th>Patient</th>
<th>Case</th>
<th>Initial Pain</th>
<th>2nd day</th>
<th>4th day</th>
<th>6th day</th>
<th>8th day</th>
<th>10th day</th>
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</thead>
<tbody>
<tr>
<td>Intuitiva</td>
<td>Acute</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Quimera</td>
<td>Acute</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Corellia</td>
<td>Acute</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gama José</td>
<td>Acute</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Concerto</td>
<td>Acute</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CW</td>
<td>Acute</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cruz</td>
<td>Acute</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Carola</td>
<td>Cronic</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Duende</td>
<td>Cronic</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Buchi Pascal</td>
<td>Cronic</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Poroto</td>
<td>Cronic</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
RESULTS
The pain quickly improves in acute cases and a variable in cases of chronic infection with treatment of late-onset.

<table>
<thead>
<tr>
<th></th>
<th>Días de tratamiento</th>
<th>Nro. de aplicaciones</th>
<th>Periodicidad</th>
<th>Alta Clínica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agudos</td>
<td>6</td>
<td>3</td>
<td>48 hs</td>
<td>10mo. día</td>
</tr>
<tr>
<td>Crónicos</td>
<td>10</td>
<td>5</td>
<td>48 hs</td>
<td>20avo. día</td>
</tr>
</tbody>
</table>
RESULTS

The SYNOVIAL fluid improves quickly in acute cases and variably in cases of chronic infection with late-onset treatment, showing an increase of viscosity (hilaluronate) in correspondence to their normalization in white cells and total protein count.

<table>
<thead>
<tr>
<th>Paciente</th>
<th>Caso</th>
<th>Día de inicio</th>
<th>Séptimo día</th>
<th>Décimo día</th>
<th>Quinceavo día</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intuitiva</td>
<td>agudo</td>
<td>52000 CB - 4,3 PT</td>
<td>9000 CB - 2 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Quimera</td>
<td>agudo</td>
<td>42000 CB - 3,6 PT</td>
<td>10900 CB - 2,7 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Corellia</td>
<td>agudo</td>
<td>23000 CB - 3,8 PT</td>
<td>5000 CB - 2 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Gama José</td>
<td>agudo</td>
<td>18000 CB - 5,2 PT</td>
<td>3000 CB - 2,3 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Concerto</td>
<td>agudo</td>
<td>56000 CB - 5,6 PT</td>
<td>2700 CB - 2 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>CW</td>
<td>agudo</td>
<td>72000 CB - 4,2 PT</td>
<td>10500 CB - 4 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Cruz</td>
<td>agudo</td>
<td>6000 CB - 2,9 PT</td>
<td>1800 CB - 2,2 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Carola</td>
<td>crónico</td>
<td>87000 CB - 5 PT</td>
<td>18000 CB - 4 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Duende</td>
<td>crónico</td>
<td>44000 CB - 4,5 PT</td>
<td>10400 CB - 2 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Buchi Pascal</td>
<td>crónico</td>
<td>23000 CB - 4,8 PT</td>
<td>6900 CB - 4,6 PT</td>
<td>normal</td>
<td></td>
</tr>
<tr>
<td>Poroto</td>
<td>crónico</td>
<td>300000 CB - 4,5 PT</td>
<td>170000 CB - 5 PT</td>
<td>normal</td>
<td></td>
</tr>
</tbody>
</table>
Ozone therapy proved to have certain advantages in the treatment of septic arthritis in horses.

- The first advantage is the **velocity**, it is not necessary to wait for the results of bacteriology to initiate specific therapy (antibiogram). **Ozone** is the effective "antibiotic" NOT DEPENDANT to the type of bacteria causing the infection.

- It has shown that it is capable of reducing the "biofilm", a form of bacterial resistance which makes failing many of the conventional treatments.

- In addition to its antimicrobial effect, it produces an Antiinflammatory and trophic effect on damaged cells.

- It is more economical than conventional treatment.
CONCLUSION

Ozone therapy was effective for the treatment of septic arthritis in horses and provided a great therapeutic safety.

Allow more distance between lavajes and applications joint (48 hours), showing advantage over conventional treatment that is daily until remission of infection.

It can be combined with systemic antibiotic therapy.

This clinical trial will result in other double-blind studies to standardize the results.

muchas gracias