FOOTHILL ABORTION
(EPIZOOTIC BOVINE ABORTION : EBA)

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FOOTHILL ABORTION

Distribution: CA, NV & OR

- Up to 90% fetal mortality (1st exposure to ticks)
- Window of susceptibility (60-140 days gestation)
- Term abortions/weak calves
- Diagnosis: Pathology does not develop until ~100 days post-infection

The Pajarollo Tick

Distribution: Mexico, CA, NV & OR

- Rapid feeders (15-20 minutes)
- Larvae > nymphs (multiple stages) > adult
- Long-lived (~10 years?)
- Greatest activity: May-October
DIAGNOSIS

- History of the dam
- Gross and microscopic pathology
- Serum immunoglobulin
GROSS PATHOLOGY

Enlarged Lymph Nodes

Tongue & Gums

Eye

Enlarged Spleen (liver not involved)

Mucosal Hemorrhages

Thymus

Internal Gross Pathology

Ascites

Enlarged, Mottled Liver
- Challenge model developed for predictable transmission of foothill abortion to susceptible pregnant heifers:
  - Cryopreserved fetal thymus harvested from select infected term fetuses
  - Very reliable if you find the right fetus!
## Antibiotic Studies

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose/ Schedule</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracycline + Penicillin</td>
<td>Tet (IP&lt;sup&gt;1&lt;/sup&gt; &amp; IM&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>Protection</td>
</tr>
<tr>
<td></td>
<td>Pen (SQ&lt;sup&gt;3&lt;/sup&gt; &amp; IV&lt;sup&gt;4&lt;/sup&gt;)</td>
<td></td>
</tr>
<tr>
<td>Tetracycline</td>
<td>LA200 &lt;sup&gt;2&lt;/sup&gt;</td>
<td>Protection</td>
</tr>
<tr>
<td>Penicillin</td>
<td>Aquacillin (SQ&lt;sup&gt;3&lt;/sup&gt;) &amp; Procaine (IV&lt;sup&gt;4&lt;/sup&gt;)</td>
<td>Protection</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>1 dose at challenge</td>
<td>No</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>1 dose at 45 days post - challenge</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>1</sup> Oxytetracycline, IP, 100mg/ml, 1X/day for 3 days  
<sup>2</sup> LA200, IM, 9mg/lb, 3 day intervals for 3 weeks  
<sup>3</sup> Aquacillin, SQ, 17,500 U / lb, 2x / day for 7 days  
<sup>4</sup> Procaine Penicillin, 10mil U, once @ 24hr PC
Antibiotic studies proved the causative agent is a bacterial.

Molecular biology identified the bacteria:
- **δ-Proteobacteria**
  - **Myxobacteria**
    - An odd group of fruiting-gliding bacteria
    - Many are soil organisms

Referred to as the “agent of EBA”

Proposed scientific name: *Pajarellobacter abortibovis*
ALTernate Host for EBA

P. abortibovis-Infected Immunodeficient Mice
VACCINE CANDIDATE:
Cryopreserved murine-derived live bacteria

SCID MOUSE

Infected thymus &/or spleen

INFECTED MOUSE
SPLEEN CELLS

Determine # of Infected Cells

VACCINATE
Current status of foothill abortion vaccine
ADVERSE REACTIONS:

- Data collected from >2000 head on 10 ranches
- Immediate reactions (i.e. anaphylactic shock) – None noted to date
- Systemic delayed reactions – None noted to date
- Localized injection site reactions
  - Soft swelling
    - Beginning ~ 3 weeks post vaccination
    - Lasting 1 to 5 weeks
    - Usually not noticed unless palpated
- Conception rates: similar between groups
- Embryonic losses: ??
  - 5 to 10% greater losses noticed in vaccinated heifers compared to controls (3 herds)
  - All were in studies with heifers vaccinated <5 weeks prior to breeding
  - Only noted in large groups of heifers with tight breeding times (30-45 days) or SFREC research herd in which heifers were preg checked at monthly intervals
  - Interval between vaccination & breeding extended from 4 to >8 weeks
  - Data collected to date suggests the problem has been solved!
Experimental Challenge Trials (needle & syringe challenge)
Performed at UNR Main Field Station (collaborators since 1992)

- Free from tick vector = *NAÏVE HEIFERS!*
- Variables tested in 4 completed trials:
  - Dose requirement (1 vs. 2 vaccinations): Year #s 1 & 2
  - Vaccine potency (how much bug/dose): Years #’s 1-4
  - Increased interval between vaccination and breeding to 6 weeks: (Year #4)

<table>
<thead>
<tr>
<th>Vaccinates</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% EBA</td>
</tr>
<tr>
<td>Year #1:</td>
<td>0%</td>
</tr>
<tr>
<td>Year #2:</td>
<td>0%</td>
</tr>
<tr>
<td>Year #3:</td>
<td>0%</td>
</tr>
<tr>
<td>Year #4:</td>
<td>0%</td>
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YEAR #5-7 : CURRENT and UPCOMING STUDIES:

- Length of vaccine immunity: 1 or 2 years?
- Studies to better understand embryonic mortality in Yrs #2 & 3
- How early can we vaccinate?
  - Testing younger heifers (8-10 month) in combination with BANGS vaccine
UC Sierra Foothill Research & Extension Center (SFREC)
- ~100 heifers enrolled each year
- Year 1: 0% EBA in Vaccinates; 10% EBA in controls (100% of fetuses recovered)
- Year 2: 0% EBA in Vaccinates; 2% EBA in controls (100% of fetuses recovered)
- Year 3: Data not yet analyzed

2011-13: ~1800 head from 8 Private Producers (2 S. CA, 5 N. CA, 1 NV)
- 2 Ranches showed significant losses in the controls compared to EBA vaccinated heifers
  - Ranch #1 (N. CA): 95% healthy calves from vaccinates compared to 44% from controls
  - Ranch #2 (N. CA): 98% healthy calves from vaccinates compared to 72% from controls
- Remaining ranches: No statistically significant difference between vaccinates and controls

Of fetuses recovered and submitted for diagnosis, all EBA positives were from controls (i.e. no break in the vaccine documented)
2013-14: Focus on field efficacy

- Safety study requirements were met in 2011-12

~650 head from 6 Private Producers (5 in N. CA, 1 in NV)

- Interval between vaccination and breeding increased to a minimum of 6 weeks
- Dosage reduced ~4-fold from previous year
- Vaccine administered with repeater “guns” to better simulate field conditions
  - Individual syringes were used in 2011-12 to insure consistent dosing for each animal
Completed studies  
- Items required by USDA

- "Minimum Effective Dose" - complete
  - This sets the minimum potency for the vaccine
  - Naïve vaccinated heifers were challenged with the bacteria
  - A recent study targeted at lowering the minimum effective dose was just completed at UNR (Year #4)
    - All vaccinated animals had healthy calves
    - 90% of controls aborted with EBA-positive calves

- "90-day Withdrawal period" – USDA approved 10/2013

- Field safety and efficacy studies (12 total)—completed
  - 8 commercial herds
  - 2 research herds over a 2 year period

REPORTS FOR ALL OF THESE STUDIES ARE BEING PREPARED FOR SUBMISSION TO USDA
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- Items required by USDA

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TARGETS for Vaccine production

- Establish a Business Plan
  - Marketing/Distribution
    - Results from a CCA study were provided
      - 6% response w/ 91% of those indicating they would purchase vaccine (est 12,000 doses)
    - Expand market by establishing current endemic area: north-central Oregon, SW Idaho?
      - Several ranchers in central OR have been approached to provide fetal tissues/dam serum samples

- Start-up Capital
  - Production facilities
  - Production personnel
  - Equipment
  - Distribution network
  - Pre-distribution production of vaccine

- Production Facility:
  - Production facility (including mice facilities) has been identified at UCD
  - USDA pre-inspection performed in late June
    - Awaiting feedback from USDA

- Establish “Scale Up” in Production - priority
  - Maintaining sterility
  - Identifying appropriate machinery for filling and capping

- Establishing “Master Seed” and sub-serials
  - Testing: Bacteria, Mycoplasma, Select viruses