Assessment of using Acoustic Pulse Technology (APT) at the dry-off period for the treatment and prevention of Mastitis

Gabriel Leitner, Eddy Papirov, Sala Shefy
Armenta, Israel
Antibiotics: Current practice and it’s consequences

- The dry-off period is an important resting period between lactations.

- During that period, invasion of bacteria could occur, leading to mastitis in the following lactation.

- Long-term antibiotic use is currently being practiced to treat intramammary infections and protection against new infections.

- The widespread use of antibiotics causes the development of antimicrobial resistance (AMR) which poses a major public health hazard.

- Consequently, health authorities are prohibiting the widespread use of these drugs, leaving farmers with no available solution for treating and preventing mastitis while leading to greater financial losses.
New Treatment Option: APT – Acoustic Pulse Technology

- APT – also known as shockwave therapy - is a multidisciplinary method that has been used over the last 35 years in orthopaedics, physiotherapy, sports medicine, urology and veterinary medicine.

- Shockwaves are mechanical waves featuring a steep pressure rise in nano seconds range.

- A compressive phase causing a tissue strain (macro effect) followed by tensile phase causing cavitation (micro effect).
Biological effect of APT (Low Energy Shock Waves)

- Shear stress activates endothelial nitric oxide synthase (ENOS) to generate Nitric Oxide

- Shockwave-elicited mechano-transduction to elevate endothelial progenitor cells (EPCs) through transformation from bone marrow-derived mononuclear cells (BMDMNCs), and EPC mobilization

- Shockwave also triggers the expression of stromal cell-derived factor 1 (SDF-1) that facilitates homing of EPCs to the ischemic site.

- Shockwave also induces the expression of vascular endothelial growth factors (VEGF) that contributes to angiogenesis.

Schematic illustration of anti-inflammatory and pro-angiogenic effects of extracorporeal shockwave
APT’s acoustic pulses are generated via ballistic impact powered by high pressurized air.

The APT device generates low intensity pulses at therapeutic energy flux density covering a large area of the shape of a truncated cone at 50 mm x 150mm x 300mm.
Previous experience with APT

Cows with clinical and subclinical mastitis has shown bacterial elimination, increased milk yield and lower SCC.

<table>
<thead>
<tr>
<th>Location</th>
<th>Farms</th>
<th>Cows sub clinical</th>
<th>Cows clinical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>APT</td>
<td>Control</td>
<td>APT</td>
</tr>
<tr>
<td>Israel</td>
<td>8</td>
<td>331</td>
<td>60</td>
<td>22</td>
</tr>
<tr>
<td>USA</td>
<td>3</td>
<td>100</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>France</td>
<td>9</td>
<td>14</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Italy</td>
<td>3</td>
<td>13</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary of results: Subclinical

Control

Recovered 23.5%

APT

Recovered 74.4%

APT=257
Control=55
Summary of results: Clinical

APT=22
Control=26

Control
Recovered 20.7

APT
Recovered 77.3%
The aim of this study was to evaluate the effect of APT on cows during the dry period as an alternative to current dry cow therapies.
Fifty cows, APT and control, were treated during dry-off periods, 4-5 weeks before parturition.

Cows were paired according to lactation, daily milk yield, DIM, SCC, history of infection, bacteriology and number of infected quarters. In each pair, one cow was then assigned to APT and the second to control.
Results

Average SCC (x1000) during the first 100 d of the lactation pre the dry period and that of the current one

**SCC (1000)**

- SCC in the APT group was 53% lower post treatment compared to the same period pre treatment
- SCC in the control group was 54% higher post treatment compared to the same period pre treatment
Average different in Milk yield during the first 100 d of the lactation

- Milk yield in the APT group was 5% to 15% higher (>Lac 1) than in the control group.
Discussion

Despite many years of efforts to control mastitis, this infection is still one of the leading causes of economic losses to the dairy industry worldwide.

- Estimating losses of clinical mastitis is straightforward: the infection is visible and requires treatment due to animal welfare.

- Dealing with subclinical mastitis presents different challenges because in many of the cows there are no recognizable symptoms and the milk appears normal. Calculations of subclinical mastitis include various costs, such as: diagnostics of the infecting agent, veterinary services, medication, labor, discarded milk, decrease in milk production, premature culling and mortality. The infection is not visible and the cost involved in treatment during the lactation is too high.
Acoustic pulse therapy (APT) opens an opportunity for treating subclinical mastitis during lactation, increasing the possibility of higher MY and quality and may lead to reducing the need for dry therapy.

The new APT treatment of clinical and subclinical mastitis can:

• 1. significantly reduce the use of antibiotics;
• 2. significantly reduce milk discarded during treatment;
• 3. can be used to treat subclinical mastitis during lactation;
• 4. can improve milk quantity and quality during the lactation, probably due to the increased healing process of the damaged tissues;
• 5. can decrease culling of subclinical mastitis cows due to low milk production and low milk quality.
• 6. ATP can be an alternative treatment during dry period
Discussion

• Therefore, cow longevity in the cowshed can be increased and forced culling can be reduced.

• Thus, the percent of replacement heifers will be reduced and milk production will be increased, as older cows produce more milk than young ones (+15%).

• Holding fewer cows can significantly reduce the use of antibiotics; producing the same quantity of milk, saving food, lowering treatment expenses and labor and obtaining higher milk production.

• Repeated treatments can also increase recovery success for SCC and microbial improvement.
Thanks

Dairy Farm Challenges During Lactation

**Sub-Clinical Mastitis:**
Sub-clinical mastitis, identified by high SCC (>250,000 cells/ml), could reduce milk production by 10%-15% and can lead to premature culling.

**Clinical Mastitis:**
Loss of milk during clean-up period from antibiotics followed by reduced milk yield. Some cases end up in culling preventing future milk production.

**Low Yield Heifers:**
Low yield heifers could reach breakeven point sooner in the lactation curve and shorten the lactation period (premature culling).

**Dry-period:**
Risk of entering into the next lactation with infection that will reduce overall milk production throughout the lactation period.