Physiological factors contributing to lamb mortality

R. Nowak, M. Chniter & M. Hammadi
Birth: one of the most challenging episode in life

Foetal environment protected

Finding food

Stress of birth

Maternal care

In a diverse environment
A mother-infant symbiosis ...
... and a neonatal race to find the udder

End of pregnancy:
- Glucose
- \(\beta\)-hydroxybutirate
- Insulin-like Growth Factor 1
- Progesterone
- Maternal immune system

A birth:
- Very little energy reserve
- No immunological protection
- Gut epithelium “open” for 24h

Lactogenesis
Mammary Gland
Colostrum accumulation
Immunoglobulins
Methods

Experimental farm in Chenchou (Gabes)

D’man sheep

Birth 3 days Survival

- Rectal temperature
- Glucose
- Total proteins or IgG
- Cholesterol and triglycerides
- Cortisol

3 categories of lambs: Light – Medium – Heavy
Sample size: 29 - 360
## Neonatal rectal temperature, glucose & protein levels

<table>
<thead>
<tr>
<th>Age</th>
<th>Temperature (°C)</th>
<th>Glucose (mmol/L)</th>
<th>Proteins (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12 h</td>
<td>39,05 ± 0,04&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2,79 ± 0,15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>62,30 ± 2,42&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>33,60 - 40,30&lt;sup&gt;b&lt;/sup&gt;</td>
<td>(n = 312)</td>
<td>(n = 93)</td>
</tr>
<tr>
<td>24-36 h</td>
<td>39,28 ± 0,03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3,87 ± 0,15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>78,31 ± 1,68&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(n = 281)</td>
<td>(n = 91)</td>
<td>(n = 78)</td>
</tr>
<tr>
<td>48-60 h</td>
<td>39,27 ± 0,04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4,17 ± 0,15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>77,56 ± 1,59&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(n = 210)</td>
<td>(n = 80)</td>
<td>(n = 76)</td>
</tr>
</tbody>
</table>

Chniter, unpublished
IgG transfer from mother to lamb

![Graph showing IgG transfer from mother to lamb](image)

- 32%
- 53%
- 74%

Colostrum
Lamb plasma

Chniter, unpublished
### Neonatal cortisol, cholesterol & triglyceride levels

<table>
<thead>
<tr>
<th>Age</th>
<th>Cortisol (ng/mL)</th>
<th>Cholesterol (mmol/L)</th>
<th>Triglycerides (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-12 h</td>
<td>74.34 ± 10.55</td>
<td>1.29 ± 0.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.70 ± 0.03</td>
</tr>
<tr>
<td></td>
<td>(n = 20)</td>
<td>(n = 60)</td>
<td>(n = 49)</td>
</tr>
<tr>
<td>24-36 h</td>
<td>70.65 ± 7.5</td>
<td>1.36 ± 0.09&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.74 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>(n = 20)</td>
<td>(n = 58)</td>
<td>(n = 54)</td>
</tr>
<tr>
<td>48-60 h</td>
<td>61.34 ± 9.32</td>
<td>1.59 ± 0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.81 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>(n = 19)</td>
<td>(n = 58)</td>
<td>(n = 52)</td>
</tr>
</tbody>
</table>

Chniter, unpublished
Neonatal glucose, protein, cholesterol & triglyceride levels: effect of birth size

Chniter et al., 2013
Neonatal physiology and survival up to 30 days

N = 19 - 60

- Proteins (g/L)
- Cortisol (ng/mL)
- Cholesterol (mmol/L)
- Rectal temperature (°C)

Total
- Alive (311)
- Dead (49)

Chniter, unpublished
Neonatal glucose, protein, IgG & cortisol: effect of birth size

N = 29 lambs

Chniter et al., 2014 (in preparation)
Neonatal physiology and survival beyond 3 days

N = 29 lambs

Chniter et al., 2014 (in preparation)
Survival relies on:

1. Increase in glucose, cholesterol and protein levels (IgG)
2. Decrease in cortisol levels which are high at birth
3. Stable body temperature, above 39°C (drop immediately after birth)

- Light lambs are penalized compared to medium and heavy lambs
- And consequently lambs born from large litters are penalized compared to lambs born from small litters
Main conclusions: the story is not that simple...

It does not mean that large litters should be avoided !!!

1. Not all ewes are equal in terms of colostrum production or quality. The amount of colostrum available at birth and its quality can be boosted in ewes bearing several lambs (Branchero et al., 2004, 2007; Hashemi et al., 2008).
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2. Not all the lambs are equal at birth. A newborn lamb is what it has become during pregnancy: it should be prepared at the time of conception and all through gestation (Oldham et al., 2011; Thompson et al., 2011).
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3. In triplet-born lambs, mortality is not influenced by birth weight itself, but the birth weight of the litter mates. Reducing the variation in birth weight within a litter will increase the competitive ability for survival of each lamb (Morel et al., 2008).
Thank you