

Meningeal worm (deer, brain worm)

Parelaphostrongylus tenuis

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- Parasite of White Tail Deer - Nonpathogenic
- Small ruminants are an abnormal host (sheep, goats, llama, alpaca)
- Parasite has indirect life cycle – snails and slugs needed for infection

Prevalence of *P. tenuis* in White-tailed Deer

➤ New York

- 58% of adults
- 33% of juveniles
- ~90% of hunter killed deer around Ithaca

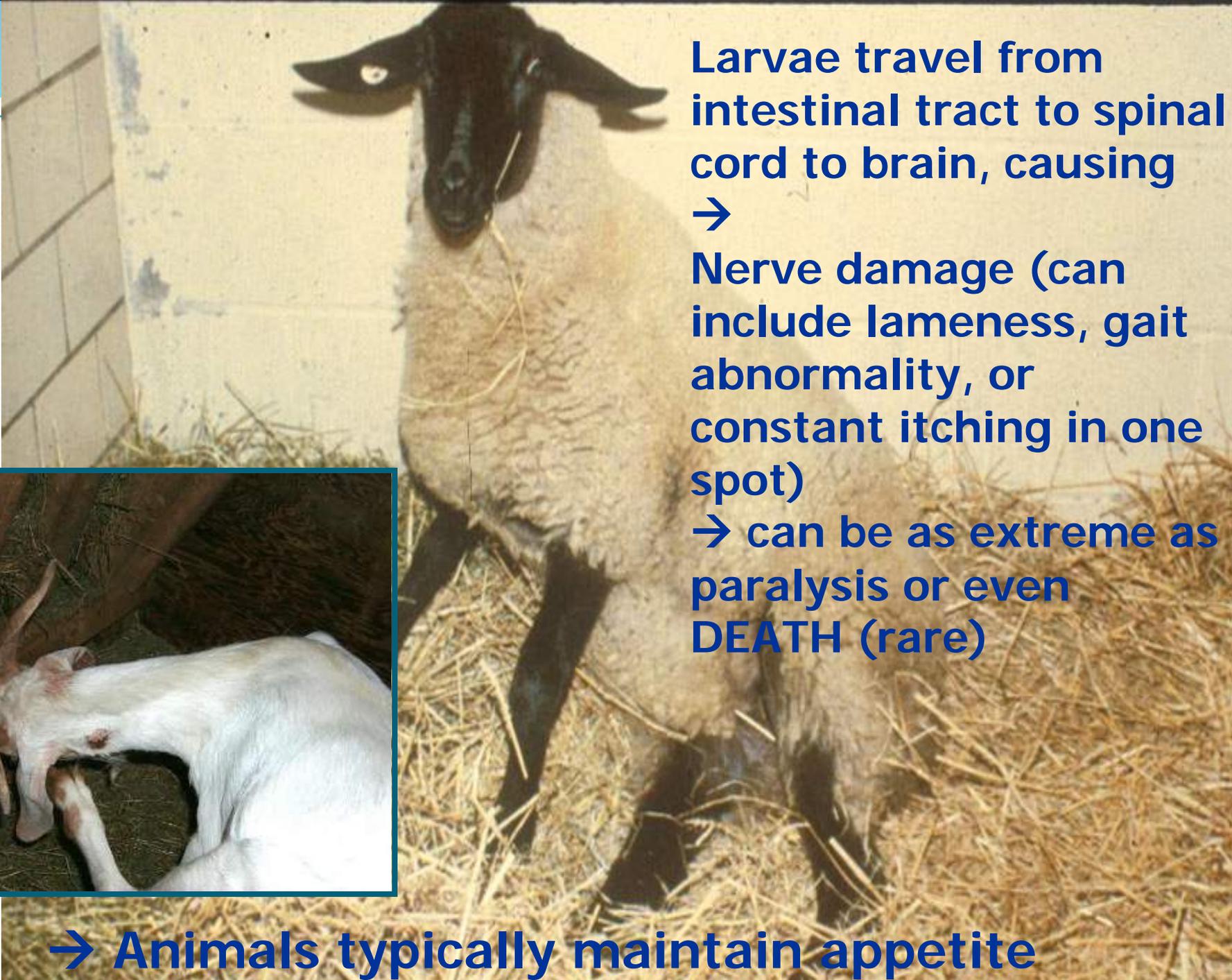
- Few in each deer
- but very long living



Infection of Aberrant Hosts

- stay longer in spinal cord
- worms active, coil on themselves
- may reinvade cord or brain
- immune response
- usually don't produce eggs to complete life cycle

- Current research – takes a little over 3 months to develop to L3 in snail -> possibly less chance of infection for about 3 months after winter is over
- Sheep or goat does not have to eat the snail or slug. The L3 emerge from snail/slug in slime trail and can survive on vegetation
- After about 10 days of infection much harder to kill worm in sheep or goat. May take 60 days for signs to develop.



Larvae travel from
intestinal tract to spinal
cord to brain, causing



Nerve damage (can
include lameness, gait
abnormality, or
constant itching in one
spot)

→ can be as extreme as
paralysis or even
DEATH (rare)



→ Animals typically maintain appetite

Treatment of *P. tenuis* in aberrant hosts

- no controlled studies in sheep and goats
- Cornell has just completed the 3rd year of an on-farm study comparing two treatment protocols on naturally infected sheep and goats on 14 farms in Ithaca, NY region
- Infected animals scored on a “neurologic score card” and video taped within the first day or two of treatment and post treatment

Cornell On-farm Experiment

Protocols (for 30 kg [66 lb.] goats or lambs)

8 cc Safeguard or Panacur (10% Fenbendazole) orally for 5 days or 25 mg/kg;

This is 5 times the labeled dosage for a one day treatment (2.5 times the one day dosage generally recommended to treat barber pole worm in goats)

At 25 mg/kg for 5 days, 10 day meat withdrawal for goats and 56 day for sheep (FARAD)

Cornell On-farm Experiment

Protocols (for 30 kg [66 lb.] goats or lambs)

CONT.

3 cc **dexamethasone injectable** 2 mg/mL IM for 3 days, followed by 1½ cc for 2 days (**0.2 mg/kg live weight for first 3 days and 0.1 mg/kg next 2 days**).

However, dexamethasone can induce labor in late pregnancy → Ewes and does in last month of gestation will receive flunixin meglumine (Banamine®) 50 mg/mL at the rate of 1 cc/100 lb. live weight (1.1 mg/kg) orally for 5 days instead.

Cornell On-farm Experiment

Protocols (for 30 kg [66 lb.] goats or lambs) CONT.

1 ½ cc **Ivermectin Placebo SQ** for 5 days (Control) or 1 ½ cc **ivermectin 1% injectable SQ** for 5 days (Ivermectin); 15 mg per 30 kg live weight or **0.5 mg/kg**, 500 µg/kg;

This is 2.5 times the labeled one day dosage (1.25 times the one day dosage normally recommended to treat barber pole worm infections in goats)

This 5 day dosage → 96 day withdrawal both goats and sheep

Theoretically, Ivermectin cannot pass through the blood brain barrier → should not aid in treatment

Infected sheep



Infected sheep – post treatment



Infected goat



Infected goat – post treatment



Current Status

- 38 animals included in the study thru December 2015 (20 goats from 4 farms and 17 sheep from 6 farms).
- Of 18 sheep,
 - 13 improved at the end of the 5 day treatment period but one of these was euthanized because of complications with pregnancy toxemia and uterine torsion. The remaining 12 either remained in the breeding flock or were sold as normal market animals.
 - 1 ewe showed no improvement but lambed with triplets 3 days later and then greatly improved and remained in flock.
 - 4 sheep showed no improvement or worsened and were euthanized. 2 had gotten Treatment A & 2 got Treatment B.

Of 20 goats -

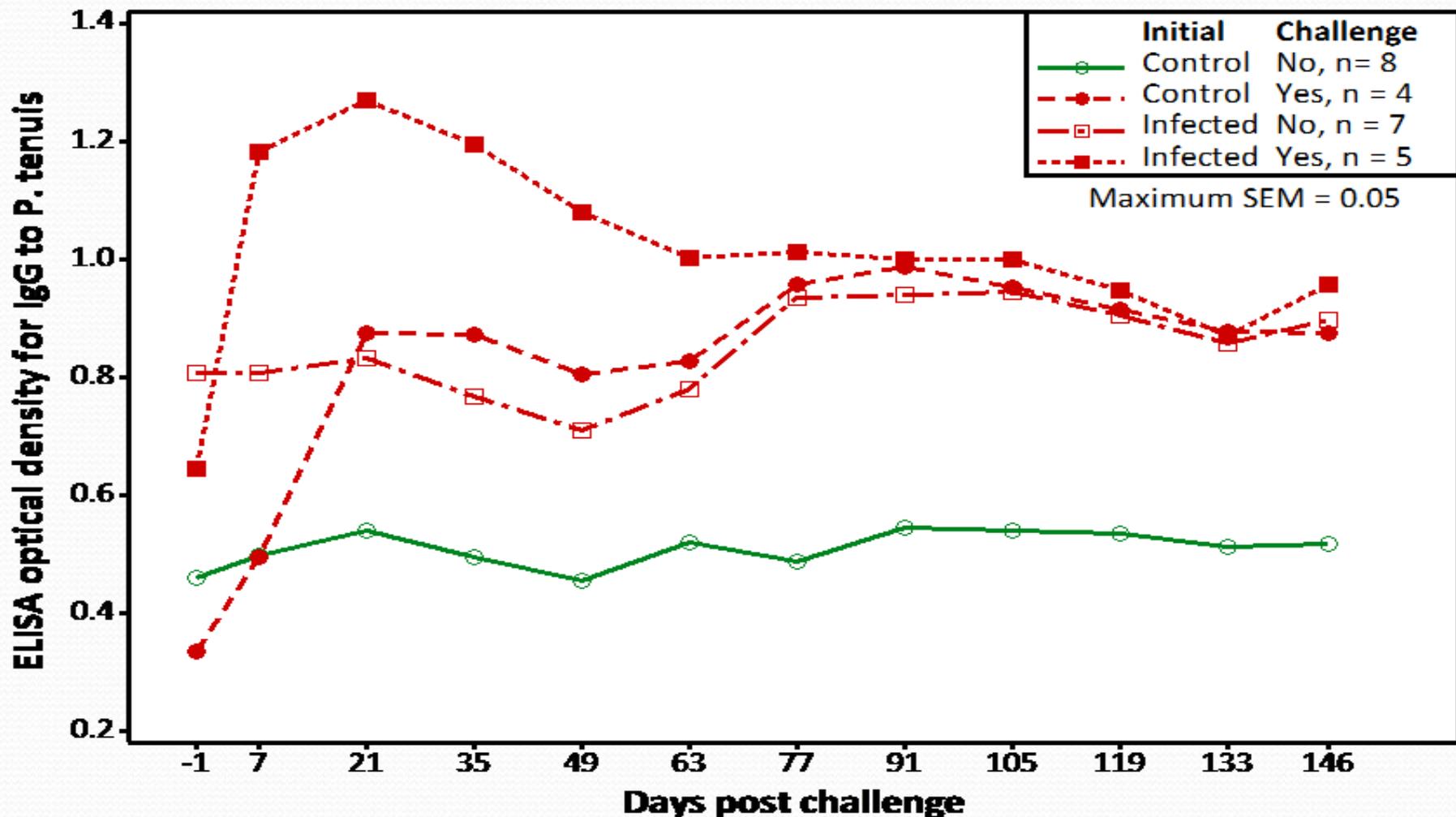
- 17 improved at the end of the treatment period and continued to improve,
- 1 was unchanged at the end of the 5 day treatment period but gradually greatly improved,
- 1 was worse but gradually greatly improved and has remained productive in the breeding herd.
- 1 showed symptoms Sep 2015, improved slightly but relapse or was reinjured in October and is currently unable to walk without assistance.

19 of 20 treated goats either remained in the breeding herd or were sold as normal market animals.

Animals excluded from study

- 28 animals were excluded.
- In some cases, they also showed signs referable to brain diseases such as polioencephalomalacia. Thus, we were unable to determine if their problem was truly deer worm and they were given thiamine as well. All of these improved.
- Other animals were excluded because they had close by slaughter dates and the owners wanted to knowingly exclude ivermectin from the treatment or skip all treatment.
- Lastly, some animals were excluded because we could not get to them in a timely manner or erroneously told the owner that the study was over, and the owners started treatment without us and knew whether they were getting ivermectin or not.

Figure 1. Serum antibody concentrations to *P. tenuis* in 19 mo. old ewes initially in a control group or a group treated with 20 L3 at 7 months of age and then challenged or not challenged with 100 L3 at 19 months of age ($P < 0.001$ for the Initial x Challenge x Day interaction using a repeated measures model with ewe as a random effect).



Conclusions

- Preliminary results of on-farm suggest no advantage to including ivermectin as part of the treatment
- We had no Control Group. However, general consensus is that our recovery rates especially for goats were far better than if animals had been left untreated
- Anecdotally, events such as breeding and birthing stress animals that have exhibited noticeable neurological damage from deer worm even if the animals initially appear to have recovered well. However, animals that are caught early before they are showing signs worse than a slight hesitation to a hind leg seem to recover fully. Starting treatment early appears to improve recovery rate.
- Challenge study indicates the potential for a deer worm vaccine for sheep & goats