

MAEDI VISNA IN NOVA SCOTIAN SHEEP FLOCKS

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Catherine Vallis and Gwyneth Jones

INTRODUCTION

Maedi visna (MV), or ovine progressive pneumonia (OPP), is a progressive, ultimately fatal chronic wasting disease caused by a slow acting virus (MVV). There is no cure or vaccine. Symptoms develop over months to years and are typically seen in animals at least 3-4 years old. This results in production losses at an age when ewe productivity should be highest (Iowa State University, 2015; Ontario Sheep News, September 2016). A closely related viral strain causes caprine encephalitis arthritis (CAE), which is widespread in goats

Maedi visna is widespread in most sheep-raising countries, but there have been few studies of MV prevalence in Canada (Arsenault et al., 2003). Simard and Morley (1991) reported 40% of tested sheep and (91%) of tested flocks were seropositive in Quebec, compared with 19% of sheep and 63% of flocks in Canada overall. This may reflect higher rates of confinement production in Quebec. Arsenault et al. (2003) found an overall seroprevalence of 32% among 29 flocks in Quebec, with flock-specific prevalence ranging from 3% to 70%. No recent studies have been undertaken in Nova Scotia, and the only information comes from individual producers who have tested their own flocks. Of these, 4 farms were seronegative (three tested only once, on the whole flock or a sample; one tested every 2 years to maintain this status) and 2 were seropositive.

The main effects of MV are premature culling of unproductive or thin ewes, reduced milk production leading to lower lamb survival and lower weaning weights (Arsenault et al. 2003). If the ewe's productive life is shortened by as little as 2 years, this could mean the potential loss of 2-4 or more lambs, plus the extra cost of premature ewe replacement. The virus is also relevant to the developing sheep dairy industry, and to purebred sheep producers who face competition interprovincially with producers in Ontario and Quebec who can participate in provincial programmes (OSMA 2012; CEPOQ 2017); Quebec buyers in particular have always been supporters of the Atlantic Fall Sale of breeding stock.

The virus

Both maedi visna virus (MVV) and caprine encephalitis arthritis virus (CAEV) are closely related small ruminant lentiviruses (SRLVs). These are RNA viruses capable of integration into host DNA by reverse transcription. The genus *Lentivirus* includes immunodeficiency viruses in cats, cattle and humans as well as equine infectious anaemia virus; SRLVs, however, do not cause immunodeficiency. The main target cells of MVV and CAEV are cells of the monocyte-macrophage line, although other cells can also be infected. Blood-borne monocytes transport provirus throughout the body, and viral transcription occurs when the monocytes differentiate into macrophages in various organs. Viral replication in infected macrophages results in an inflammatory cascade (Larruskain and Jugo, 2013; Minguijon et al., 2015).

Tissues are infiltrated with immune cells including lymphocytes resulting in immunopathological changes leading to fibrosis and reduction in organ function (Blacklaws, 2012).

This chronic inflammatory response in target tissues, mainly the udder and lungs in sheep, results in eventual clinical signs of a firm udder with scanty milk production (hard bag) and chronic pneumonia (OPP) (Larruskain and Jugo, 2013; Iowa State University, 2015). Neurological symptoms can occur (but not commonly in North American strains of MVV), and involvement of the nervous system and joints (CAE) is prevalent in goats. Other organs, including heart, liver and kidneys, may also be affected (Blacklaws, 2012). Late stage respiratory and neurological disease lead to wasting and death; the mammary and arthritic syndromes by themselves do not usually cause wasting and death, but are often a reason for culling on the grounds of loss of production or locomotor impairment (Minguignon et al., 2015). However, many animals are asymptomatic, and clinical signs may only be apparent in flocks with a high incidence (Synge, 2013).

Since the immune system cannot clear the virus, infection is lifelong and continuing inflammation leads to increasing tissue damage. Weight loss, exercise intolerance and respiratory distress can occur in older animals. Even younger animals, although asymptomatic, can transmit the virus through respiratory secretions or colostrum and milk, and prevalence can increase rapidly in a flock. Uncontrolled it can reach a high incidence in flocks.

Small ruminant lentiviruses are highly variable due to mutation, recombination and host immune effects, resulting in numerous strains. Worldwide five genetic groups have been identified, originally from sheep (A) or goats (B, E), or geographically limited (C, D). Subtypes (A1-15, B1-3, E1-2) are common. Molecular analyses indicate that subtypes A2 and B1 are present in Canada, in sheep and goats respectively (Fras et al. 2013; Santry et al. 2013). However, cross-species transmission between sheep and goats has been demonstrated in mixed flocks in Quebec, including dual infections with both subtypes in one sheep and two goats (Fras et al. 2013). Close contact between sheep and goats could therefore present a significant risk and complicate efforts at control.

Transmission

The mode of transmission influences possible programmes for eradication of the virus at farm level. Transmission has been considered to be primarily through lambs ingesting colostrum and milk from seropositive dams. Recommendations for control have consequently focused on removal of lambs at birth, before suckling or even licking by the ewe. More recent studies have shown that this is much less significant than a respiratory route, and infection is primarily through prolonged contact (nose-nose or shared air space) (Broughton-Neiswanger, 2010). Animals housed in close contact (confinement systems, winter housing, lambing barns) are most at risk and much higher incidences have been recorded from intensive housed flocks compared with extensive flocks on pasture (Leginagoikoa et al. 2010) In Canada the need for winter housing means that there is an increased risk of transmission at this time.

There is some evidence for breed effects, with Texels and Border Leicesters showing higher seroprevalence than Suffolks and Ile de France, and individuals also appear to vary in susceptibility (Larruskain and Jugo, 2013).

Prevention and control

Testing and culling, or separating infected animals away from contact or shared air space, is currently the only way to reduce incidence. There is no treatment or vaccine, and control programmes depend on the availability of sensitive tests. The test in current use at the Animal Health Laboratory, University of Guelph, is an indirect ELISA (HYPHEN Elitest) to detect antibodies (core and envelope) in circulation, with a specificity of 99.3% and sensitivity of 95% (Ontario Sheep News 2016). The high specificity minimises the chance of false negatives, but up to 5% of results could potentially be false positives. Where this is suspected, a secondary test can be used for confirmation.

Ontario and Quebec have voluntary MV flock monitoring programmes to assist efforts to eradicate MVV from participating flocks. The programmes are compatible and require testing all animals over 6 months every 4-8 months until 2 consecutive tests are negative, followed by annual testing of a random sample of animals 1 year or older. Introduced or returning animals are tested twice before joining the flock (OSMA, 2012; CEPOQ, 2017).

Three options are available for producers with a seropositive flock:

1. Whole flock testing and culling, including offspring of positive ewes. This can achieve rapid progress, but can cause problems in large flocks, if prevalence is high or if genetics are at risk (OSMA (2012)).
2. Separation of positive and negative groups (no nose-nose contact or shared air space). Even a 1.2 m solid barrier can be adequate (Polledo et al., 2013) if both groups must be housed in the same barn. Lambs can be snatched at birth and raised on bovine colostrum and milk replacer (OSMA 2012). It is also possible to separate pregnant ewe lambs as a separate lambing group since they are lower risk (OSMA, 2012).
3. Breeding ewes in the infected flock are managed as a single unit, *regardless of test status*, and allowed to birth and raise all lambs to weaning. Offspring selected for replacements and found to be OPPV negative post-weaning, but prior to 12 months of age, are permanently segregated and periodically re-tested to confirm their continuing test-negative status (Newman and Neaton, 2017).

Both Ontario and Quebec offer voluntary MVV accreditation programmes which require testing all animals including replacements over 6 months, every 4-8 months until consecutive negative tests, and random sampling thereafter. This has become a financial problem in Nova Scotia, since the cost is now \$14.25/test (+ \$17.27 courier charge and \$4 handling fee per submission) plus veterinarian fees. However, if the initial flock status is known, replacement animals alone can be separated and tested so that over a number of years a negative flock may be achievable.

SURVEY RESULTS

Recruitment

An information brochure and an invitation to participate were compiled and distributed in May and early June. The project was advertised through SPANS (website and emailing), NSFA (enewsletter), Facebook (Maritime Sheep and Maritime Livestock Facebook pages), together with brochures at Atlantic Stock Yard and the PSBANS field day in July. An information booth was set up at the Atlantic Sheep Sale and the Annual Meetings for SPANS and PSBANS. A further email invitation was sent out in September, and communications continued until February 2018.

Responses

In response, 29 registration packages were submitted; from these, 18 producers registered for the programme and 14 completed testing. Veterinarians' costs were cited as the main reason for non-participation.

We recommended submitting samples by late August so that, if needed, follow up tests after 4-6 months could still be covered. One producer retested animals; another could not arrange sampling before the mid-February deadline, and this producer plans to resample in the spring, even though at full cost.

The number of tests per farms ranged from 15 to 112. Three producers tested their whole flock; two exceeded the 50 sample limit, and paid for the additional tests at full cost. For other producers, the tests covered a sample of the flock and we encouraged them to concentrate on older animals which are more likely to be seropositive.

Results: Overall, 48 positive tests were recorded out of a total of 702. At least one seropositive animal was detected in 7 of the 14 flocks (50%). Within flock seropositivity ranged from 0.9% to 60%, with a mean of 20.7% positive animals per flock sampled. However, 6 of the 14 flocks (43%) were purebred, and of these only one producer had a single positive result (0.9%). Among the 8 commercial or mixed flocks, 6 (75%) had positive results (mean of 24.2%). Commercial flocks represent the majority of flocks in Nova Scotia, and this suggests that the overall incidence of infected flocks may be substantially higher than 50%. One producer purchased a ram from an untested flock; it was isolated and tested positive, indicating another positive flock in the province.

Two flocks each had a single positive result, which on retest were in fact confirmed as negative. The Elitest process used by the Animal Health Laboratory in Guelph has high sensitivity (>99%) but slightly lower specificity (95%), and we encouraged retesting in these cases. The secondary test used, an IDEXX Elisa, has lower sensitivity but high specificity (98.7-100% compared to a CFIA Elisa) (Ontario Sheep News 2016), and if this test returns a negative result the animal is considered to be negative. The producer with one positive animal out of 112 opted to cull, not retest, because the flock previously had positive animals.

DISCUSSION

These results are comparable with those from an earlier study in Canada (19% of sheep and 63% of flocks tested positive: Simard & Morley, 1991) and a recent study in Minnesota (of 8 flocks, 2 were negative, 2 minimally affected and 4 with a range of prevalence from 21% to 96% (Lewman and Neaton, 2017). Higher levels of infection were recorded in Quebec (40% of tested sheep and 81% of tested flocks (Simard & Morley, 1991), which probably reflects much greater use of intensive confinement operations in that province. Viral transmission is primarily through respiratory secretions although transmission through colostrum and milk is also significant; estimates that maternal transmission accounts for 10-30% of cases are reported (Lewman and Neaton, 2017).

The current blood test is highly sensitive (99.5%) and specific (95%). However, retesting single positive animals in both flocks that requested it indicated that they were probably false positives. Retesting could be advisable if fewer than 5% of animals in a whole-flock test were positive, or if they had been purchased from a MVV-negative flock and not subsequently in contact with others (Ontario Sheep News 2016). Purchased animals should be quarantined and tested.

Although this is a small sample, the high incidence of infection in commercial flocks shows that this is a common health and biosecurity problem, and one that can easily be introduced into a seronegative flock with a purchased animal. Knowing the status of a flock (positive or negative, and seroprevalence if positive), producers can work towards eliminating or minimising the virus. For seronegative purebred flocks there may be an advantage to joining the Ontario accreditation scheme, which requires testing at 4-6 month intervals until two consecutive whole-flock results are negative followed by further tests of a random sample.

It is possible to make progress by weaning replacement lambs early and keeping them segregated from the ewe flock. Testing only the lambs at 6-12 months, with periodic retesting, and culling positive adult ewes, can gradually establish a seronegative flock. In the Minnesota study, 3 of the 4 heavily infected flocks have achieved 100% negative status after 5 years with this protocol (Lewman and Neaton, 2017). However, the high per-test cost plus veterinary costs are a severe disincentive to many producers, and it is probable that any producer in this province purchasing animals from untested flocks is at high risk of introducing the virus.

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APPENDIX

Additional information from producers:

1. One farm has tested all animals annually: incidence in 2011 was 38%. After culling or separating, incidence in 2012 was 13%. The test was unavailable in 2013 when the available test was discontinued in Canada, but in 2014 incidence was 3.7%. Clearly progress can be made. However, no testing was done in 2015 and in 2016 incidence was up to 9%. In the present study, incidence was only 0.9% (1 of 113 animals). This included four 8-month old ewe lambs from seropositive dams; two were retested in February as yearlings, and remained seronegative. No attempt had been made to isolate these lambs, and they remained with the ewes from February to September.

Isolation during winter housing in 2011/12 was a simple 4' high plywood partition in a corner of the lambing barn. In 2015/16, yearling ewes were housed in the same barn as 8 seropositive animals, separated by a 4 m space and two plywood partitions; none of these yearlings tested positive later in 2016, or in this study.

2. Four other purebred producers have tested independently, either the whole flock or a sample. All have been seronegative. At least one of these producers has followed up the initial whole-flock test with testing any purchased animal.

3. One farm had tested previously, and has sent this account of the results:

Maedi Visna Lambing Statistics 2015

Background: The flock was tested for Maedi Visna previous to lambing season. The flocked tested approximately 45% positive. After some culling the positive and negative ewes were separated into two "different barns". These barns were separated by a wall and door. The same diet was provided at the same feeding rate to the different barns.

There were 44 ewes in the negative group and 31 in the positive group. These groups seemed somewhat representative of the whole flock with the exception of age. The Maedi Visna positive flock had a few less ewe lambs thus increasing its average age slightly. The significance of this is that ewe lambs will have a slightly lower lambing rate.

Results: The Maedi Visna negative barn had 79 lambs born (all lambs counted including DOAs) for a lambing percentage of 180. There were one lamb that was a “Dead on Arrival” and 2 deaths within the first month (death rate does not include DOAs) thus, putting DOA rate at 1.3% and the death rate at 2.5% for a combined total loss of 3.8%.

The Maedi Visna positive barn had 57 lambs born (all lambs counted including DOAs) for a lambing percentage of 180. There were 4 lambs that were “Dead on Arrival” and 2 deaths within the first month (death rate does not include DOAs) thus, putting DOA rate at 7% and death rate at 3.5% for a combined total loss of 10.5%.

Conclusion: With the difference in ewe flock age from one group to another the Maedi Visna negative group had a better lambing percentage as it had younger ewes having more lambs. This number is hard to quantify as ewe lamb’s lambing percentage differ from mature ewe’s lambing percentage from flock to flock and breed to breed.

With respect to lamb mortality rates the Maedi Visna negative group lost approximately one third of the lambs that the Maedi Visna positive group. Thus being a huge savings by making the flock disease free as it costs the same amount to have a dead lamb born or die as it does to have a live lamb born or live. On 100 lambs born a Maedia Vinsa negative flock should be able to market approximately 9 more lambs with the same fixed costs.

4. One participant in this study gave the following observation:

I guess I should have checked beforehand, but I ended up paying just shy of \$12 per ewe, including blood work. Granted, that included a positive sample which meant a second visit from the vet, plus the courier costs for that single sample (no results on that one yet). There was a technician involved during the first visit. Overall, it seemed like a fairly costly undertaking with 49 ewes. I realize it is good to try and support these programs, but from a purely financial point of view it is very difficult to justify.

I was thinking about this issue over the last few days and one thought was that it might be useful to start a dialogue with the vets, if they are willing, about programs such as these. The vets are the immediate beneficiaries of these schemes, and it would be healthy all 'round to have them as a partner rather than a I see them a bit like a guild only the shepherd guild is not as powerful. A case in point is the processing of the samples. My vet (and another producer had the same experience) wanted to process the samples in their own lab rather than encourage us to use the Truro lab which is free. Fortunately, I was given the heads up on that one. That's almost as bad as the Canadian banks selling unnecessary services. Granted, my vet is young and only an associate vet and probably needs to earn her stripes before becoming a partner, but this is the kind of information the producers need to know beforehand. and if the vets participated in this process the optics would be so much better. Who knows, if the vets were seen as partners than they might even see more farm calls.

