Fetal loss in maiden ewes – an update

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Introduction

Fetal loss in maiden ewes (ewe hoggets or two-tooth ewes) has been reported in New Zealand since the late 1990s when ultrasonographic pregnancy scanning became commonplace. In this article fetal loss is characterised by mid-gestation pregnancy loss without obvious expulsion of aborted materials. On-farm this is detected by either the presence of non-viable fetuses identified in-utero during ultrasonographic pregnancy diagnosis, or when ewes are confirmed pregnant at an initial pregnancy diagnosis but at a subsequent pregnancy diagnosis are found to be non-pregnant.

This article provides an update on what is currently known about fetal loss in maiden ewes, including outcomes of a recent survey and on-farm investigation (Ridler 2014, Ridler et al. 2015a).

How common is it?

A small study was undertaken in 2013 where New Zealand veterinarians and diagnostic labs dealing with cases of fetal loss in maiden ewes were asked to notify researchers at Massey University. Affected flock owners were asked to fill in a survey to gather basic flock-level information (Ridler 2014). Only 31 affected flocks were identified, of whom twenty responded to the survey. Thirty one affected flocks is likely a large under-representation of the true number but nevertheless suggests that the problem is relatively uncommon nationally.

On a within-flock basis the flock-size adjusted mean percentage of affected maiden ewes was 11%, with a range from 2–59% (Ridler 2014). The identification of fetal loss in most of the flocks was based on the identification of dead or dying fetuses during routine pregnancy scanning, i.e. at a single time point, so these figures likely under-represent the true percentage of affected ewes. Hence while affected flocks would appear to be uncommon, large losses may be experienced by those flocks that are affected.

It is likely that a certain level of fetal loss in maiden ewes should be considered ‘normal’ but it is unknown what level this would be.

What investigation has been undertaken?

Investigations into infectious causes

A number of on-farm investigations have been undertaken by veterinarians, some of which have been published (West et al. 2004, Marshall 2014). In general the clinical investigative procedure has been to collect blood samples from affected and unaffected dams, and to euthanise affected dams and undertake diagnostic testing (bacteriology, serology, histology). In most cases no infectious pathogens have been identified although West et al. (2004) identified *Leptospira interrogans* serovar Pomona (L. Pomona) as a possible cause in one of five cases they investigated.
Ridler et al. (2015a) investigated the impact of L. Pomona and *Leptospira borgpetersenii* serovar Hardjo-bovis (L. hardjo) on fetal losses in a commercial flock that had an unconfirmed possibility of L. Pomona-associated fetal losses the previous year. One third of the 1,325 ewe lambs were vaccinated against these serovars while the other two thirds were not, and a subset of 124 non-vaccinated ewe lambs were regularly blood sampled to monitor seroconversion. Fetal loss was significantly higher in non-vaccinated ewe lambs compared with vaccinates (9% vs 5%) and amongst the blood-sampled group there was a strong association between seropositivity to L. Pomona and fetal loss. There was no association between L. hardjo and fetal loss. The exposure to leptospires on this farm was high; from April to August around 50% and 90% of the monitored ewe lambs seroconverted to L. Pomona and L. hardjo respectively.

West et al. (2006) suggested a possible role of *Neospora caninum* in fetal losses and subsequent research studies have further investigated the possible role of *N. caninum*. Weston et al. (2009) demonstrated that inoculation with high doses of *N. caninum* tachyzoites in mid-pregnancy resulted in abortion. Howe et al. (2012) investigated commercial flocks with ongoing unexplained abortion problems and high-fertility flocks as a comparison. A range of diagnostic tests for *N. caninum* were utilised including maternal serology (IFAT and ELISA), PCR of maternal and fetal tissues, and histology. They concluded that the presence of *N. caninum* (identified via serology or PCR detection) may be involved in at least some cases of unexplained sheep abortion but additional testing such as histology would be required to conclusively diagnose it as the cause of abortion.

*Toxoplasma gondii* and *Campylobacter fetus fetus* are the two most common causes of ovine abortion in New Zealand. However in virtually all reported cases of fetal loss in maiden ewes the ewes had been appropriately vaccinated against these pathogens and there was no evidence of their involvement in the fetal losses (West et al. 2004, Marshall 2014, Ridler 2014).

In a 2013 survey of affected flocks, 13 of 20 flock owners reported that there had been veterinary investigation into the fetal losses in their flocks (Ridler 2014). In 12 of these 13 flocks no infectious causes were identified. The final flock had an unconfirmed possibility of L. Pomona involvement and this was further investigated and confirmed the following year (Ridler et al. 2015a).

In summary, most clinical investigations have not identified infectious causes of fetal loss although L. Pomona and *N. caninum* have been implicated in a small number of cases. It should be noted that affected fetuses are often macerated or mummified and at times this may have limited their diagnostic usefulness.

**Nutritional studies**

In the UK rapid weight gain during pregnancy in the magnitude of 234–323g/day, achieved by feeding a concentrate diet, resulted in high levels of fetal loss (Wallace et al. 1996, 1997). The same has not been reported in rapidly-growing pasture-fed sheep in New Zealand (Morris et al. 2005, Kenyon et al. 2008, Mulvaney et al. 2010) although their growth rates were unlikely to be as high as those described by Wallace et al. (1996, 1997).

In a large flock in which the association between leptospirosis and fetal loss was investigated (Ridler et al. 2015a), the effects of liveweight, liveweight changes, body condition score and fetal number were also investigated in a total of 5,115 ewe lambs.
Overall the flock experienced 7% fetal losses and a low mating weight and/or poor weight gain between mating and first pregnancy scanning were associated with increased levels of fetal loss. Similarly Sakata (2011) reported that ewe lambs with fetal loss had lower growth rates in early-mid pregnancy compared with those that didn’t have fetal loss. It is unknown how or why this would affect fetal loss or whether this finding is repeatable across farms, but it will be further investigated in 2015.

In a survey of affected flocks (Ridler unpublished), eight of 15 flock owners reported that they fed maiden ewes during gestation to achieve minor weight gain (<100g/day), six reported that they fed to achieve moderate weight gain (100–250g/day) and one reported that they fed to achieve rapid weight gain (>250g/day). The recommended growth rate target for ewe hoggets during gestation is 100–150g/day (Kenyon et al. 2014).

In summary, various studies have been undertaken to identify the causes of fetal losses but with no definitive outcomes. It is possible that fetal losses are caused by a range of different agents or physiological pathways and the exact cause varies from farm to farm, or alternatively that most are due to an as-yet unknown cause.

Is there further work planned?

In 2015 Massey University is undertaking a study on a small number of farms that had fetal losses in ewe hoggets in the previous year. The 2014-born ewe hoggets have been electronically identified and will be weighed and body condition scored regularly. They will be pregnancy scanned on three occasions to identify cases of fetal loss. Serum progesterone levels will be monitored and laboratory diagnosis will be undertaken on ‘fresh’ cases of fetal loss.

If I am dealing with a case of fetal loss in practice, what should I do? (Ridler et al. 2015b)

In all cases a thorough history should be obtained. If there appears to be a likely reason for the losses or there are areas that need to be further explored then these should be investigated.

Anecdotally, it would appear that if abortions have occurred as well as in-utero fetal loss then an infectious cause is more likely to be identified (compared with cases where only fetal losses are seen). If abortions have occurred then undertake a standard abortion diagnostic work-up.

If no abortions have occurred and the problem is restricted to in-utero death and resorption then decisions need to be made. Undertaking laboratory testing is relatively expensive – for example Marshall (2014), who undertook laboratory testing on five affected ewe hoggets and their fetuses, reported laboratory costs alone of over $3000. Given that a diagnosis of an infectious agent is uncommon in many cases of fetal loss, deciding not to undertake further investigation is a valid option.

If further investigation is undertaken the ideal option is to re-scan the pregnant ewes one week after the first pregnancy scanning. The diagnostic quality of resorbing fetuses is frequently poor as they are often macerated or mummified and re-scanning allows identification of new, fresh cases. Three to five newly-affected ewes should be euthanized for collection of maternal and fetal tissues as follows:
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**Ewes**
- Fresh and fixed placentomes – including maternal caruncle.
- Fixed section of non-placentome associated uterus.
- Fixed ovaries.
- Representative fixed tissues – Liver, lung, spleen, kidney, heart, GIT, brain (HOLD AT CLINIC).
- Fresh lung (FREEZE).
- Fresh liver, spleen and kidney (FREEZE).
- Serum from up to 10 affected ewes and 10 non-affected (still pregnant) ewes (HOLD).
- Faecal samples.

**Fetuses – avoid mummified fetuses if possible**
- Fresh stomach contents.
- Fresh thoracic fluid/heart blood/CSF.
- Fresh placenta.
- Fresh lung.
- Fresh liver, spleen, kidney.
- Fixed tissues including placenta, liver, lung, spleen, kidney, heart, brain, diaphragm, tongue, thymus, thyroid.

Fetal stomach contents should be subjected to aerobic culture and fetal heart blood/fluid for Toxoplasma serology. Fetal tissues, placentomes, maternal uterus and ovaries should be subjected to histology.

If nothing is found then further testing can be done on held tissues as considered appropriate. Examples would include:

- Pestivirus PCR on fetal spleen or fluids.
- Serological testing of serum from affected ewes for Pestivirus, Neospora (ELISA) and Leptospira pomona, hardjo +/- copenhagenii. If positive the serum from non-affected ewes to compare.
- If histology is suggestive of fetal loss syndrome and no other causes have been identified then consider FEC ewes +/- sick animal profile on bloods +/- histology maternal tissue.
- Aerobic culture of frozen maternal tissue if histological lesions are identified in those tissues.

In cases where fresh cases of fetal loss are not available, the only laboratory diagnostic option possible is to collect serum from 10 affected and 10 non-affected ewes for serum antibody testing. Note this is relatively expensive and that serum antibodies are only indicative of exposure, not of causality. The main pathogens to consider testing for are Pestivirus, Neospora (ELISA) and Leptospira pomona, hardjo +/- copenhagenii. If this option is chosen then initially only test the sera from affected ewes – if antibodies are detected to any of the pathogens then test the sera from non-affected ewes for that pathogen to compare titres between groups. Differences between groups are not confirmatory but may be indicative of that pathogen's involvement.
Summary

While fetal loss in maiden ewes appears to be quite uncommon it can cause large losses on affected farms and is a source of frustration for both farmers and veterinarians. In a small number of cases there has been evidence of L. Pomona or N. caninum involvement but in the majority of cases there has been no apparent evidence of infectious agents. Further studies into this problem are being undertaken but it is unlikely that they will provide a magic solution. Veterinarians dealing with cases should obtain a thorough history and follow-up any areas of concern. If abortions are present a diagnostic abortion work-up should be undertaken but otherwise careful consideration should be made about whether or not to undertake laboratory diagnostic investigation.

Acknowledgements

Thanks to Geoff Orbell (New Zealand Veterinary Pathology) and Fraser Hill (Gribbles Veterinary) who assisted with the section on diagnostic investigation.

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