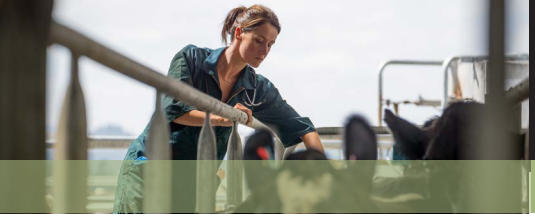

PRODUCTIVITY EFFECTS OF AN IBR OUTBREAK IN A NZ DAIRY HERD

Background and case description

In spring 2016 an outbreak of upper respiratory tract infection was observed within the lacating two year old heifers at the Lincoln University Dairy Farm in Canterbury. In early November, 3 of these heifers were presented to the attending veterinarian. The heifers exhibited high rectal temperatures (40 - 41°C), had ocular and nasal discharge, were coughing on arrival at the dairy shed, and had sharply reduced milk production. A clinical picture of IBR was apparent so the veterinarian initiated treatment with antibiotic, NSAID and a pour-on anthelmintic to cover the differential diagnoses of IBR and lungworm. Further clinically infected lactating heifers were identified by the herd manager and treated similarly.

During the course of the outbreak, the farm manager reported that during the first four months of lactation the majority of two year old heifers were observed coughing on arrival at the dairy shed for milking. Approximately 16 of 136 heifers were subsequently treated due to the seriousness of clinical signs. Affected heifers experienced substantially reduced milk production for 4 - 10 days during the course of their disease. Most lactating heifers recovered and resumed a clinically normal appearance, however one animal died and a post mortem was undertaken.

Tissues were grossly unremarkable with the exception of the lungs, which were sampled for fresh tissue culture and histopathology. The trachea appeared normal with no evidence of lungworm. Histology revealed an acute bacterial bronchopneumonia, with bronchiolitis obliterans fibrosa lesions which are consistent with recent viral infection (such as IBR). The culture produced a heavy growth of *Trueperella pyogenes*, with evidence of Fusobacterium sp and Bacteroides sp. Blood samples were collected from 6 affected cows and submitted for IBR antibody ELISA tests, with positive results indicating prior exposure to IBR virus.

Coincidently, the herd was part of a clinical study being run by DairyNZ during the calving and mating period. This involved blood samples collected pre-calving for a large proportion of the herd (460 out of approximately 580 cows), and at 2 weekly intervals after calving. Herd milk testing was also undertaken fortnightly for the milking herd from the beginning of calving in late July until December.

To confirm the diagnosis of IBR, fresh blood samples were taken from three affected heifers, and compared with results from blood samples collected prior to the observed outbreak of disease. IBR ELISA tests were requested on the sample pairs. Two heifers tested seropositive to both samples indicating IBR exposure and seroconversion prior to the beginning of the 2016 calving period. The third heifer tested seropositive only to the second test, indicating seroconversion as a result of IBR exposure during the spring 2016 outbreak. This confirmed that there was active viral spread and exposure in the herd, which was the likely cause of the morbidity and mortality seen in the two year old heifers.

Study objectives

1. Determine the impact on milk production and reproduction of heifers and cows that seroconverted compared to herdmates that remained seronegative throughout the Study (impact of clinical infection)
2. Determine the impact on milk production and reproduction of heifers and cows that were seropositive in spring 2016 compared to herdmates that remained seronegative throughout the Study (impact of subclinical infection)

The IBR impact could only be quantified if sufficient cows within the herd remained seronegative, to act as controls.

Method

Detailed milk production, in-calf data and retained blood samples were available for this herd. This presented a rare opportunity to investigate the potential effects on milk production and reproduction in cows that had experienced primary infection with IBR.

A Study was designed to utilise the pre-existing data for milk production and reproduction, and use retained blood samples from animals that calved in 2016. Additional blood samples from cows were collected post calving 2017. Wherever sample pairs were available, both retained frozen blood samples from Spring 2016 and new blood samples from Spring 2017 were submitted for testing using the IBR gE ELISA antibody test.

A data set was collated from records of lacating dairy heifers and cows present in the herd in the seasons commencing in June 2016 and 2017. These data contained records of ear tag and lifetime identification numbers, date of birth, breed, calving dates, final pregnancy statuses, and milk production test results. Conception dates for calculating six-week pregnancy rates were estimated from 2017 calving dates, where the data was recorded. Cow data including herd test production data and pregnancy test data was extracted from MINDA and collated for cows that had both an initial and final blood sample.

The main outcome variables investigated were six-week and final pregnancy percentage, and total milk solids produced for the 12 months ending June 2017. Predictor variables included IBR serological status at the first blood sample (negative or positive), and paired IBR serological status at the first and second sample time points. The main covariate was age category. Logistic and linear regression models were used to determine associations.

Results

There were 467 lactating animals in the Study herd, including 136 two year old heifers, with at least one blood sample collected near calving time in spring 2016.

Study herd	N	%
Age category:	**467**	**100%**
2 yr	136	29.1%
3 - 4 yr	135	28.9%
5 - 7 yr	113	24.2%
8+ yr	83	17.8%

Table 1. Summary of study group age groups

This was a relatively high producing dairy herd for New Zealand including 95% Friesian - Jersey crossbred cows. The Study herd population is summarised in Table 1, and productivity in Table 2.

Results for 2016/17	N		Total cows
Pregnant 6 wk	309	68.8%	449
Pregnant final	381	84.9%	449
Milk production	441 kg milk solids	82 (std dev)	449

Table 2. Study herd in-calf results and seasonal milk production estimated via MINDA from individual cow data. This was lower than mean 550kg MS/cow produced in 2016/2017

Cows grouped by IBR status

368 cows had IBR antibody test results available at both time points. Cows were categorised by their paired serological status based on results at the two time points, as negative-negative, negative-positive, positive-negative and positive-positive.

Serological status by paired status and age group is shown in Table 4. The final data set for analysis contained paired records on 368 animals, as 69 mixed age cows were removed from the herd by late 2016 due to culling (n = 26), sold (n = 17), or died on-farm (n = 26), or identification issues (n = 25).

	2 year	3&4 year	5-7 year	8+ year
N	117	110	87	54
neg-neg	19 (16%)	2 (2%)	3 (3%)	0
neg-pos (seroconverted)	16 (14%)	0	2 (2%)	0
pos-neg	4 (3%)	0	1 (1%)	1 (2%)
pos-pos	78 (67%)	108 (98%)	81 (93%)	53 (98%)

Table 4. Serological status at both time points for 368 cows, grouped by 2016 age

IBR status vs reproductive performance

A logistic regression model including age group showed six week in-calf rates were not associated with IBR serological status at the first blood sample (p = 0.35). Final pregnancy status or milksolids production were also not associated with IBR serological status at the first blood sample (p = 0.25 and 0.14 respectively).

However, cows that seroconverted or remained IBR positive during the Study had lower six week in-calf rates compared with cows that remained IBR sero-negative (Table 5, p = 0.06 and 0.07).

Status	6 week I/C probabillity	P value
neg-neg	0.92	-
neg-pos	0.67	0.06
pos-pos	0.72	0.07

Table 5. Predicted probability of pregnancy at 6 weeks by paired serological status, from a logistic regression model including age.

IBR status vs milk production

Daily milk production of 2 year old IBR seronegative cows (control) were compared with IBR clinical, seroconverted (case) cows, matched for calving date.

	2 yr old	3 - 4 yr old	5 - 7 yr old	8+ yr old
	N=133	N=133	N=113	N=83
Sample 1 IBR positive	94 (70.7%)	108 (98.2%)	82 (94.3%)	54 (100.0%)
Pregnant 6 weeks	92 (70.2%)	92 (69.7%)	76 (73.1%)	45 (58.4%)
Pregnant final	117 (89.3%)	115 (87.1%)	88 (84.6%)	56 (72.7%)
Milk production (kg MS)	361.1 (46.0)	460.2 (61.1)	505.1 (58.4)	466.3 (78.6)

Table 3. Serological and pregnancy status (percentage) and milk production (mean and SD) of 368 cows included in the analysis of effects of IBR on pregnancy and milk production, grouped by 2016 age category

Daily milk solids production of the control group and case group were modelled to create lactation curves and total milk production for the full lactation (Figure 1). The estimated seasonal milk production for the control cows was higher than for cows in the case group (400kg MS vs 380kg MS).

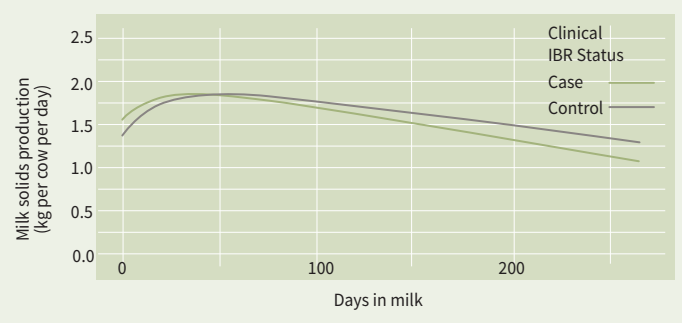

Figure 1. Predicted daily milk production for case and control cows.

Discussion

Testing of the retained blood samples revealed that the vast majority of cows aged 3+ years old in the herd were already seropositive in August 2016. Additionally 70% of the 2 year old cows were also seropositive at the first sample. This was an unexpected finding given the number of two year old heifers observed by farm staff with clinical symptoms of IBR in late 2016. Bovine herpesvirus reactivation in latently infected animals may have confounded results.

This particular herd is likely to have high levels of circulating virus due to reactivation of latent virus, particularly at stressful times during the season for the herd or individual cows, such as at calving, following severe weather events, other clinical disease, feed shortages or changes in diet. During reactivation of virus in stressed animals, any naïve cattle in contact with these cows are at risk of primary infection (and seroconversion), with possible clinical disease.

The data revealed an association between IBR paired serological status and 6-week in-calf rates, and reduced milksolids production in cows with clinical IBR. The Study had a high proportion of initially IBR seropositive cows, and consequently a low number of cows seroconverting or remaining IBR seronegative.

The high percentage of mixed age cows with positive IBR antibody aligns with earlier seroprevalence data published in NZ[1,4,7,8].

This Study showed that younger cattle were much more likely to be naïve to IBR than older animals, likely due to the reduced time period of potential exposure to IBR (shorter lifespan), and possibly fewer contact points with other cattle populations.

Anecdotally the farm manager reported a sharp drop in milk production for clinically affected animals. This observation was reinforced by the estimated 20kg reduction in milk solids produced for the season when comparing IBR clinical, seroconverted (case) cows with IBR seronegative (control) cows.

The dynamics of IBR infection and impact on milk production and reproduction demands further study, to better understand clinical disease effect on NZ dairy cow productivity. A future study should ideally be conducted in herds with a lower incidence of IBR infection so that a larger group is available for use as the negative control benchmark.

Conclusion

This Study outlines dynamics of an IBR outbreak with similarities to numerous other reports of respiratory disease outbreaks in 2 year old lacating dairy heifers first joining the milking herd in NZ. These cases have been investigated by practicing veterinarians and reported to AgriHealth.

The Study showed IBR infection was highly prevalent and caused significant clinical disease within a Canterbury dairy herd, with seroconversion occurring in previously naïve 2 year old cows.

Results suggest negative effects of IBR infection on reproduction and milk production, and indicate that further investigation of the effects of IBR in New Zealand dairy herds is warranted.

Acknowledgements

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This Study was conducted under Ruakura Animal Ethics Committee approval number 14193.

IBR and New Zealand Cattle

Infectious bovine rhinotracheitis (IBR) is caused by bovine herpesvirus type-1 (BoHV-1) and infects cattle of all ages. Typical of herpesvirus, the infection becomes life-long with virus sequestered within the nerve ganglia. The herpesvirus remains latent but will reactivate and begin shedding virus when the immune system is overwhelmed. Cows exposed to the virus and latently infected will often maintain high titres of serum antibody as a result of the ongoing viral recognition during times of reactivation.

At first exposure to BoHV-1, clinical disease results, which is usually in the form of IBR. Clinical symptoms of IBR are those of an upper respiratory tract viral infection – sneezing, coughing, high temperature (often in excess of 40°C), ocular and nasal discharges. Anorexia occurs and as a result the animals are lethargic and appear ill-thrifty, with reduced milk production in lactating cows.

The virus is present in very high concentration in the respiratory secretions, including within aerosols generated during sneezing, and can be spread by air up to 5 metres from such animals[6]. The virus is hardy in the environment and can persist and remain infective in secretions on fixtures such as walls, posts and rails, and within stock trucks for approximately 2 days.

Once an animal within a mob is infected with virus and becomes infectious, the virus is spread rapidly among naïve animals resulting in high morbidity. Mortality from IBR is uncommon however, with the majority of animals recovering from clinical disease within 5 - 12 days, although some clinical cases may evolve into a secondary upper or lower respiratory tract bacterial infection which can require antibiotics, anti-inflammatories and supportive care, and some refractive cases may result in death.

Following primary infection, seroconversion and a long-term protective antibody response occur which largely prevents clinical disease when the virus emerges out of latency, but the virus can still be shed in secretions.

Diagnosis of IBR is based on the suggestive clinical picture, and by laboratory testing for antibody (rising titre) and / or virus (PCR).

BoHV-1 is known to be widespread within NZ cattle populations.[1,4,7,8]

Prevalence studies from the late 1980's and 1990's showed that many cattle in many herds across NZ tested positive for IBR antibody and had therefore been exposed to IBR virus during their lifetime. In 1986 Durham[1] estimated the overall prevalence of IBR infection in dairy herds was 82% (91% in the North and 44% in the South Island), and was 61% in dairy cows (70% in North Island cows, and 24% in South Island cows).

In 1988 Neilson[8] also reported differences in the herd- and cow-level prevalence of IBR between regions (95% to 100% of herds and 50% to 70% of cows in the North Island, and 77% to 90% of herds and 27 to 35% of cows in the South Island).

There has been substantial growth in the dairy cattle population since this time, with plentiful movement and mixing of cattle from different areas. There have been no formal studies to understand the impact of IBR infection in NZ, nor agreed programs to reduce spread of IBR. It seems likely the prevalence of IBR has increased across the country rather than reduced over time.

In other parts of the world, IBR infection can result in early embryonic loss as well as mid to late term abortion. The abortive strain of IBR is not known to occur in NZ, and is on the list of MPI notifiable diseases. In overseas countries, identified regions and/or entire countries have established voluntary or compulsory IBR eradication programs, some of which have been successful in eradicating IBR. These programs involve hygiene and biosecurity measures, as well as testing and culling positive animals, alongside vaccination programs.

Cost-benefit calculations for IBR control in New Zealand cattle have not been published, with only anecdotal information available. It is difficult to predict when and where an IBR outbreak might occur, so collection and analysis of robust data sets have remained elusive.

There would likely be greater impetus to control and or eradicate IBR from NZ herds if productivity and economic impacts of IBR clinical and subclinical disease in NZ cattle was able to be quantified, as occurred with bovine viral diarrhoea (BVD) in NZ cattle almost ten years ago.

Vaccination with Biobos IBR MARKER VACCINE

- reduces clinical signs of disease in exposed animals
- reduces shedding of virus, by up to 10,000 times
- reduces reactivation of latency, reducing shedding of virus
- prevalence of viral antigen in the environment significantly reduced
- results in fewer infected cattle

Vaccinate prior to risk periods such as mixing mobs, mating and calving. Protect young stock from disease to ensure they have best chance to thrive.

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