Lungworm (*Dictyocaulus viviparous*) and Infectious Bovine Rhinotracheitis (IBR) in a dairy herd

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This report details the clinical and pathological findings of a respiratory condition in a dairy herd of adult cattle in Northern Victoria attributed to the co-infection of Lungworm (*Dictyocaulus viviparous*) and Infectious Bovine Rhinotracheitis (IBR).

Keywords: Lungworm, *Dictyocaulus viviparous*, Infectious Bovine Rhinotracheitis

Abbreviations: IBR Infectious Bovine Rhinotracheitis, BRD Bovine Respiratory Disease complex, BRSV Bovine Respiratory Syncytial Virus, PI3 Parainfluenza Virus 3, ELISA Enzyme Linked Immunosorbent Assay, NT Neutralization test, AGID Agar-gel Immunodiffusion Test, HIT Haemagglutination-Inhibition Test, IPV Infectious Pustular Vulvovaginitis

Introduction

Australian dairy farms tend to have fewer infectious respiratory disease problems when compared to more intensively managed beef feedlots and dairy systems elsewhere in the world. This is due to Australian climatic conditions which allows dairy cattle to be housed at lower stocking rates outdoors [1].

The main infectious respiratory disease problems seen in adult cattle include:

- Lungworm of the *Dictyocaulus viviparous*
- Pneumonic Pasteurella caused by *Mannheimia haemolytica* and *Pasteurella multocida*
- Infectious bovine rhinotrachetits (IBR) caused by Bovine herpesvirus type 1
- Bovine Respiratory Disease Complex (BRD) which is associated with the following infectious agents; IBR, Bovine viral diarrhoea virus (BVDV), Bovine respiratory syncytial virus (BRSV), Parainfluenza Type 3 virus (PI3), *Mannheimia haemolytica*, *Pasteurella multocida* and *Histophilus somni* [1]

Case report

The clinical cases occurred on a dairy property in northern Victoria. Veterinary attention was sort with the complaint of approximately 50 cows of a herd of 120 Holstein Friesian milking cows, of varying ages, were displaying varying degrees of clinical signs of respiratory disease. The signs included sporadic coughing episodes in the milking shed and a reduced milk production. The farm owner reported that the cases occurred over a 6 week period and no replacement heifers or dry cows showed clinical signs.

Three animals examined were tachypnoeic (respiratory rates between 60-80 breaths per minute), pyrexic and had harsh lung sounds particularly in the cranio-ventral lung fields as well as reportedly having a reduced milk yield. All other clinical parameters were within normal limits. It was also noted that no cows had nasal discharges despite showing respiratory clinical signs.

The cattle showing moderate to severe clinical signs were treated with oxytetracyclines and the farm owner was advised to provide the cows with a parenteral anthelmintic treatment.

One of the mature cows that displayed signs of severe dyspnoea and reluctance to move subsequently died and a post mortem was conducted. The post mortem grossly revealed a severe diffuse bronchopneumonia. Samples were collected for culture and histopathological examination.

A further veterinary visit was conducted to collect 9 faecal samples for cultures, record rectal temperatures of a number of milking cows at the time of milking (Table 1 below) and collect acute blood samples (10ml plain tube) for serology from 9 cows. Sixteen days later the veterinarian returned to take a convalescence blood samples (a second 10ml plain tube) for paired serology from the same 9 cows.

Laboratory results

Post mortem: All tissue samples, including lung tissue did not grow bacteria when cultured and hence no bacteria were identified. Histopathology of the liver, kidney, spleen and heart were unremarkable. However there were significant changes in the lungs. These changes were summarised as a severe, diffuse proliferative bronchiolitis and necrotising bronchitis with interstitial parasites (*Dictyocaulus viviparous*) (Figures 1 and 2). The diagnosis of chronic obstructive broinchiolitis (bronchiolitis obliterans) with pulmonary oedema and intralesional nematodes (*Dictyocaulus viviparous*) was made.

Faecal results: Faecal cultures were conducted to examine for the presence of lungworm (*Dictyocaulus viviparous*). No lungworms or larvated eggs were detected.

Serology: The serology results for Bovine Respiratory Syncytial Virus (BRSV) IgM ELISA, Infectious Bovine Rhinotracheitis virus neutralization test (IBR NT), Pestivirus Agar-gel Immunodiffusion Test and Parainfluenza Virus 3 HIT are summarised in table 1 below. BRSV, Pestivirus and PI3 were not considered to be major contributes to the disease outcome. It was concluded that all 9 cows had seroconverted to IBR.

Table 1. Rectal Temperature recordings and acute and convalescent blood sample results for 9 cows showing clinical signs of respiratory disease.

		Acute blood sample				Convalescent blood sample			
Cow Id	Rectal Temperature (˚C)	BRSV IgM ELISA[a]	IBR VNT[b]	Pestivirus AGID[c]	PI3 HIT[d]	BRSV IgM ELISA[a]	IBR VNT[b]	Pestivirus AGID[c]	PI3 HIT[d]
206	40	Positive	Negative at 1:2	Negative	Positive at 1:512	Negative	Positive at > 1:178	Negative	Positive at 1:512
205	38.5	Positive	Negative at 1:2	Negative	Positive at 1:256	Negative	Positive at 1:178	Negative	Positive at 1:256
173	37.9	Negative	Negative at 1:2	Negative	Positive at 1:256	Negative	Positive at 1:4	Negative	Positive at 1:256
177	37.9	Negative	Negative at 1:2	Negative	Positive at 1:256	Negative	Positive at 1:16	Negative	Positive at 1:256
250	38.2	Negative	Negative at 1:2	Negative	Positive at 1:512	Negative	Positive at 1:128	Negative	Positive at 1:512
236	38	Positive	Negative at 1:2	Negative	Positive at 1:256	Negative	Positive at 1:128	Negative	Positive at 1:256
228	38.2	Negative	Negative at 1:2	Negative	Positive at 1:256	Negative	Positive at 1:128	Negative	Positive at 1:512
212	37.2	Negative	Negative at 1:2	Negative	Positive at 1:128	Negative	Positive at 1:45	Negative	Positive at 1:128
133	38.2	Negative	Negative at 1:2	Positive 1+	Positive at 1:512	Negative	Positive at 1:22	Positive 1+	Positive at 1:1024

[a] Bovine Respiratory Synctial Virus Immunoglobulin M Enzyme Linked Immunosorbent Assay

[b] Infectious Bovine Respiratory Disease Virus Neutralization Test

[c] Pestivirus Agar-gel Immunodiffusion Test

[d] Parainfluenza Virus 3 Haemagglutination-Inhibition Test

Figure 1. Airways with inflammation and fibrin

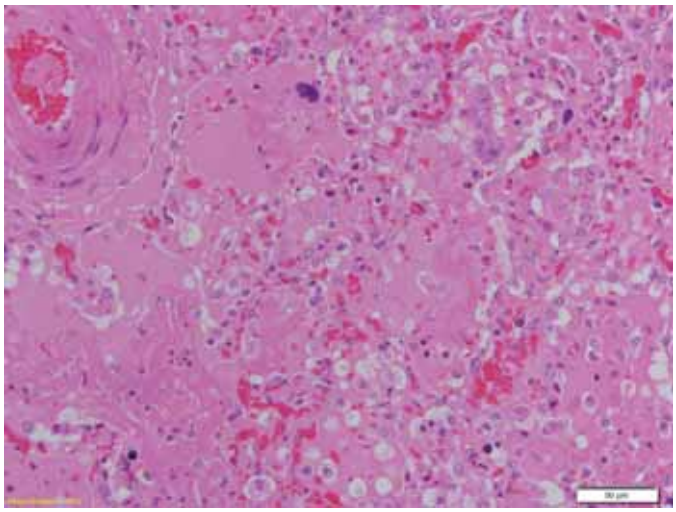
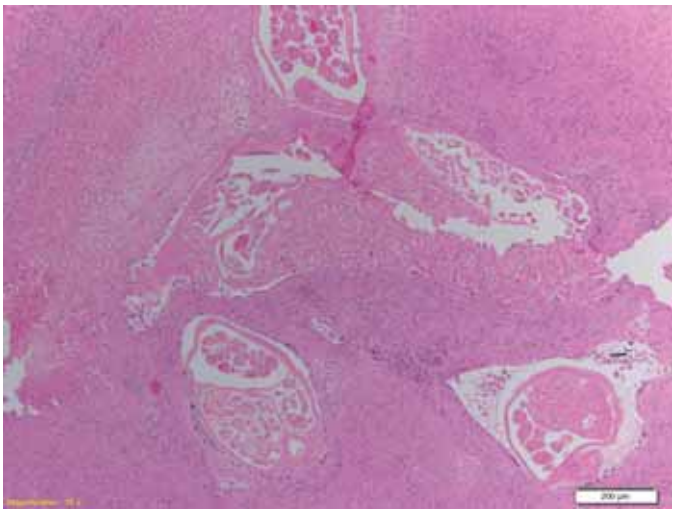


Figure 2. Airways with intralesional nematodes



Discussion

Respiratory diseases on dairy farms are less frequent than reproduction disorders, metabolic diseases, lameness and displacement of abomasum.

Respiratory disease in Australian dairy farms tend to involve the individual animal or a small group of animals [1]. In the case study farm the outbreak occurred in a small dairy herd with a high percentage of animals affected. Throughout the investigation it was found that three infectious pathogens were found to be of significance, lungworm (*Dictyocaulus viviparous*), IBR and PI3.

Lungworm (Dictyocaulus viviparous) in dairy cattle

Verminous pneumonia/ Parasitic bronchitis, caused by *Dictyocaulus viviparous* is a recognized disorder in young

stock that graze pasture [2]. The clinical disease of verminous pneumonia related to lungworm in this adult dairy cattle herd is unusual. Lungworm infection in adult cattle may follow primary exposure after failure to acquire immunity or waning of immunity in years of drought. Parasitic bronchitis also occurs in adult dairy cows through reinfection resulting in the so-called 'lungworm reinfection syndrome'. This is characterized by an immune-mediated inflammation of the lungs in response to invasion by juvenile stages of [2]. Outbreaks of parasitic bronchitis due to lungworm in adult cattle has been seen on several dairy farms in the Netherlands [3], United Kingdom [4] and Canada [5].

Lungworm is a highly pathogenic nematode with clinical signs being observed in most immunologically naive individuals. The disease is usually observed in the late summer or early autumn, however outbreaks are often reported throughout the year [4].

In younger affected animals, the clinical signs include coughing, exhibiting a rough hair coat and reduced weight gain [1]. Severely affected animals become dyspnoeic and can die or need to be culled [4]. In adult animals, the main effects observed are decreased milk yield and reduced fertility with consequent increases in calving period [4]. Approximately 1-2% of infected animals can develop a hypersensitivity reaction to the nematode and this can lead to acute respiratory distress or sudden death.

Risk factors for the development of the disease include previous history of lungworm on the property, introduction of young and/ or older lungworm-naïve animals onto a pasture based system and a warm and high moisture climate/ environment (which allows survival and promotes dispersal of the nematode from faecal pads)[1, 4, 6].

In Australia clinical disease due to lungworm is uncommon due to the widespread use of highly efficacious anthelmintics [1].

In the current case study, the disease outbreak occurred in early summer and on irrigated pasture where conditions were appropriate for the survival of the nematode. The milking cows were routinely treated with an anthelmintic at dry off. The outbreak may be explained by the low exposure to the nematodes over a long dry period and subsequent exposure to a high burden in climatic conditions favorable for parasitic survival. The negative larval culture results for the 5 faecal samples may be explained by the history of anthelmintic treatment prior to faecal sample collection.

IBR in dairy cattle

Infectious bovine rhinotracheitis (IBR) is a viral disease caused by bovine herpes virus 1 (BoHV-1)[7]. BoHV-1 is a DNA virus in the genus Varicellavirus in the family Herpetoviridae [1].

The BoHV-1 infection has many clinical presentations and the severity of each form also varies considerably from inapparent infections to overt clinical signs [1]. The clinical presentations include upper respiratory tract disease (conjunctivitis, mucopurulent nasal and ocular discharge and coughing), reproductive diseases (abortions, infectious pustular vulvovaginitis (IPV) and infectious pustular balanopostitis), meningoencephalitis and systemic infections (in which the animals present with a fever, depression, inappetance and reduce milk yield) [1, 8, 9].

The main subtypes of BHV-1 that are involved with respiratory disease are subtypes 1 and 1.2. However, BHV-1 subtype 1.2 is also responsible for the clinical disease of IPV and infectious pustular balanopostitis [7].

The disease generally has high morbidity and low mortality rates and in Australia the virus is primarily a disease of cattle. Infected cattle act as the main reservoir and source of the infection [1, 9]. The virus is shed in large quantities in ocular, respiratory and reproductive secretions [1]. The virus is spread both within and between herds mainly by horizontal transmission such as direct and indirect contact (fomites) and aerosol droplets. It may also be spread from infected bulls by coitus and in infected semen either by artificial or natural insemination [10]. Some cattle with BoHV-1 will undergo life-long latent infections where the virus remains latent in nervous tissues (trigeminal or sacral ganglion). Re-excretion of the virus may occur when these animals experience stressors such as intensive farming conditions (feedlots), transport, parturition and corticosteroid administration [1, 9]. Therefore any antibody positive animal has to be classified as infected, except in the case of vaccinated animals(induced serological response) or thoe with colostral antibodies[9].

It is important to note that BoHV-1.2b is the only strain of BoHV-1 that has been isolated in Australia. This strain in Australia causes mild disease in cattle and water buffalo but has not been detected in sheep or goats [11]. A major concern with BoHV-1 infections in cattle is that it can predispose these animals to develop severe respiratory disease such as Bovine Respiratory Disease Complex (BRD).

Outbreaks of IBR generally occur in cattle that experience a period of crowding particularly post transportation [1]. In Australia dairy herds most infections are of the respiratory form. The disease is usually one of younger animals, the 2 year old cows entering the herd being infected from older latently infected cows. The disease is usually mild, however affecting a large number of animals in a short time period [1].

The clinical expression of the disease in the affected cattle includes inappetence, coughing, profuse oral and nasal discharge and a moderate reduction to milk yield [1]. Some animals will require antimicrobial treatment and it may take up to 2 weeks for affected cattle to return to full milk production.

In the current case study, the farm did not routinely vaccinated against IBR using the commercially available, Coopers Bovillis MH + IBR®, (contains inactivated bovine herpes virus 1.2b and inactivated *Mannheimia haemolytica*). This was not an unusual finding as many dairy farms do not routinely vaccinate cattle against *Mannheimia haemolytica* or IBR. This practice is more commonly carried out in beef feedlot systems.

The herd was assumed to be initially naïve to IBR (acute blood samples were all negative) and after clinical disease was seen and serological testing performed, all the cows seroconverted to IBR (convalescent blood sample were all positive).

Parainfluenza Type 3 virus in dairy cattle

PI3 has been associated with BRD, bovine pneumonia pasteurellosis and enzootic calf pneumonia [1]. The role of PI3 in the current outbreak is unclear as the cattle were seropositive to the virus, however there was no rise in the convalescence blood samples for 8 of the cows.

Conclusions

Due to the clinical presentation and laboratory findings, it was suspected that the inciting cause for the observed clinical disease in this herd was lungworm (*Dictyocaulus viviparous*) which then predisposed the herd to an IBR outbreak in which severe clinical disease resulted.

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