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ESSENTIAL GUIDES ON CATTLE FARMING

Bovine respiratory disease

Keith D. DeDonder

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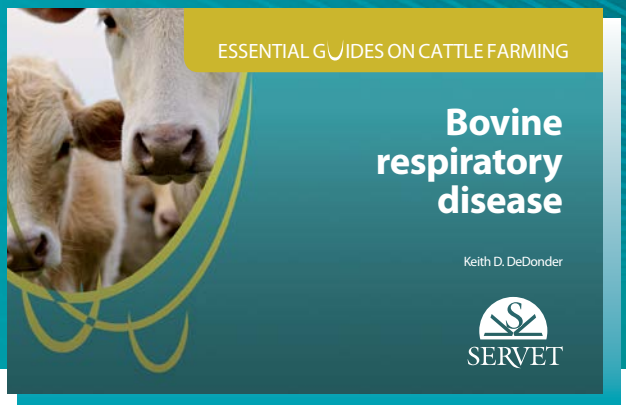

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Bovine Respiratory Disease (BRD) is probably the most common and costly disease affecting the beef cattle industry worldwide, causing damages and losses in recently weaned and feedlot cattle, nursing beef calves, housed dairy calves, and lactating dairy cows. In addition, BRD is a complex multi-factorial disease entailing the interaction between various factors, such a host factors (age, immune status, etc.), environmental factors (transport, temperature fluctuations, ventilation, etc.) and infectious agents (viruses, bacteria, etc.).

This handbook, including the most essential contents, has been carried out by a renowned expert with a wide experience in this field. Thus, this updated book (visual-type) is the most helpful tool to properly control this disease. The atlas format makes the contents understandable and accessible to readers.

Presentation of the book

Bovine respiratory disease (BRD) is one of the most costly diseases affecting production agriculture worldwide. Despite advances in antimicrobial therapy and vaccination technology over the last several decades, it remains a significant economic drain to the beef industry and a welfare concern to all stages of beef production.

Its economic and welfare issues will be presented to familiarize the introductory reader to BRD. The detailed information and pictures will capture even those most familiar with BRD. Its long discussed aetiology, epidemiology, diagnosis, and disease control measures will be presented along with the most current and cutting edge advances in these areas.

The objective of this book is to provide the veterinary student and bovine practitioner a concise, yet detailed descriptive and pictorial guide to all the most important aspects of BRD. The disease will be covered from head to tail!

Keith D. DeDonder

The author

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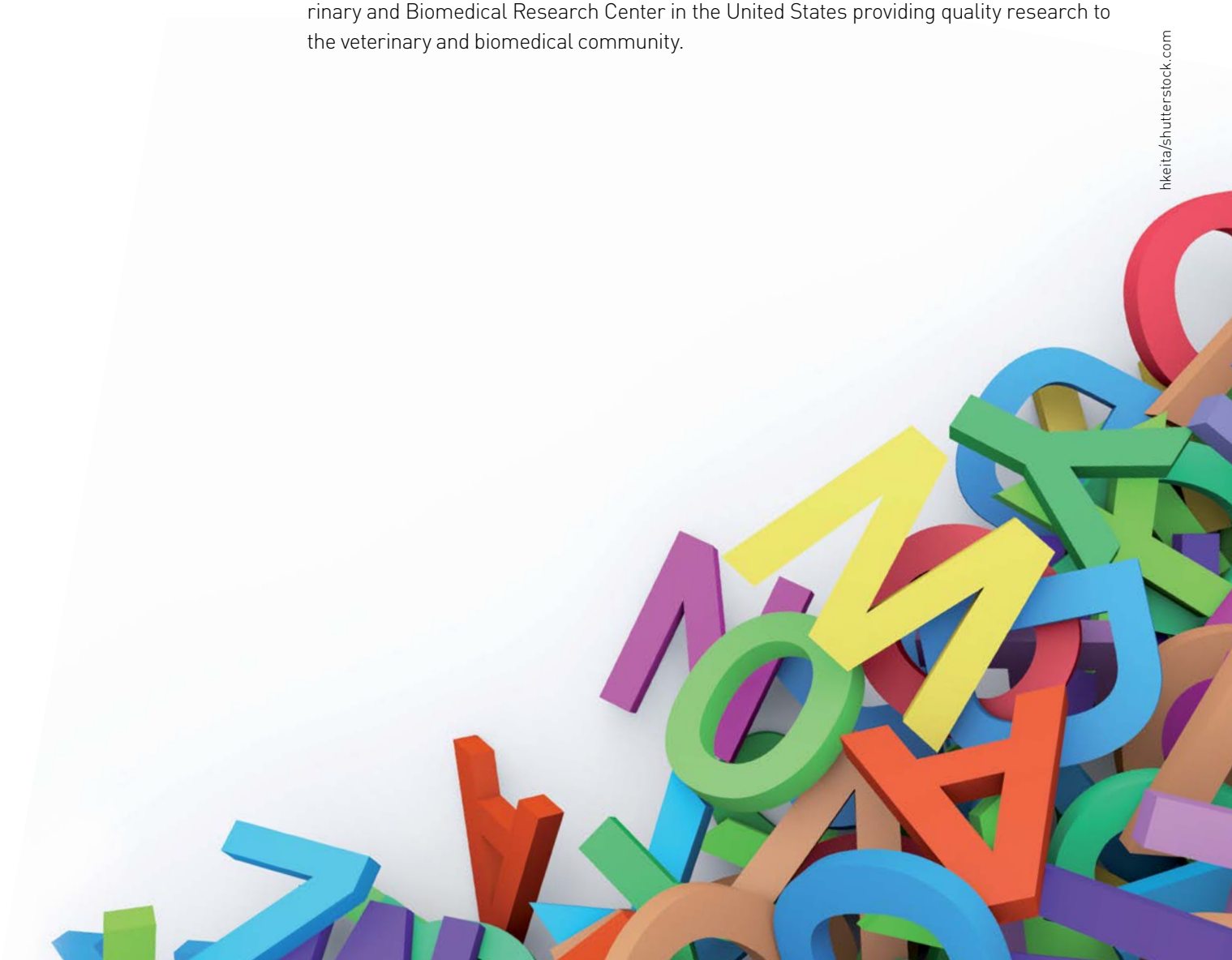
Dr. DeDonder graduated from Kansas State University College of Veterinary Medicine and spent several years in private practice before returning to pursue a PhD and complete a residency in clinical pharmacology at Kansas State University. The focus of this research was on antimicrobial resistance in bovine respiratory disease (BRD) and the effects of clinical BRD on the pharmacokinetics and pharmacodynamics of an antibiotic and its correlation to treatment outcome. Dr. DeDonder is now director of clinical services at the Veterinary and Biomedical Research Center in the United States providing quality research to the veterinary and biomedical community.



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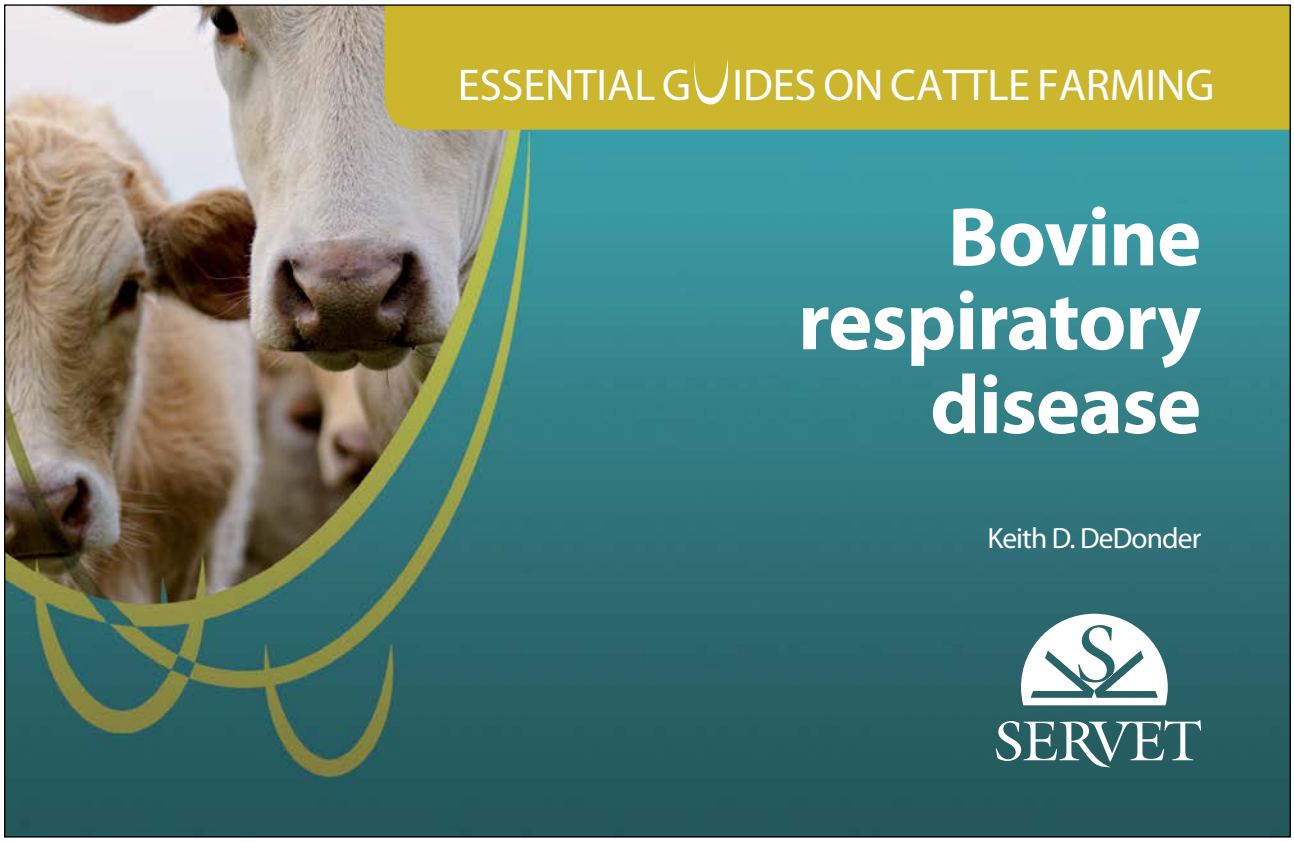
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Introduction and global importance

BRDC is a major worldwide disease affecting the cattle industry. It continues to be an economic drain globally due to lost animal production, increased labour expense, the cost of drugs used in treatment, and mortality. One North American author estimated the economic impact of BRDC globally to be in excess of $1 billion US dollars annually in the feedlot industry alone. [1] BRDC is the number one cause of morbidity and mortality in young, intensely raised cattle. [2]

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Many factors contribute and are responsible for the continued struggle with BRDC. It is a complex, multi-factorial disease with several bacterial and viral agents often implicated which are precipitated by stressful events.

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Table 1. Non-exhaustive list of stressors, viral pathogens and bacterial pathogens most often indicated as the agents or events that often lead up to BRDC. The most commonly cited scenario is a stressful event causing immunosuppression leading to viral invasion and secondary bacterial colonization.

Stressors	Viral pathogens	Bacterial pathogens
◗ Transport. ◗ Weaning. ◗ Processing. ◗ Weather extremes. ◗ Commingling.	◗ Bovine viral diarrhoea virus. ◗ Bovine respiratory syncytial virus. ◗ Bovine herpes virus. ◗ Parainfluenza virus-3.	◗ *Mannheimia haemolytica.* ◗ *Pasteurella multocida.* ◗ *Histophilus somni.* ◗ *Mycoplasma bovis.*

It is difficult to accurately diagnose BRDC due to the occurrence of non-specific clinical signs, lack of a gold-standard diagnostic test, and the fact that cattle are a prey species and therefore hide signs of disease from the observer. Cattle are anatomically and physiologically predisposed to the development of pulmonary disease. In comparison to other farm animal species, cattle have a decreased gaseous exchange capacity, lower alveolar oxygen levels during high metabolic activity, decreased pulmonary clearance, and a greater degree of compartmentalization all of which leads to a reduced phagocytic activity and a more favourable environment for infectious agents. [3]

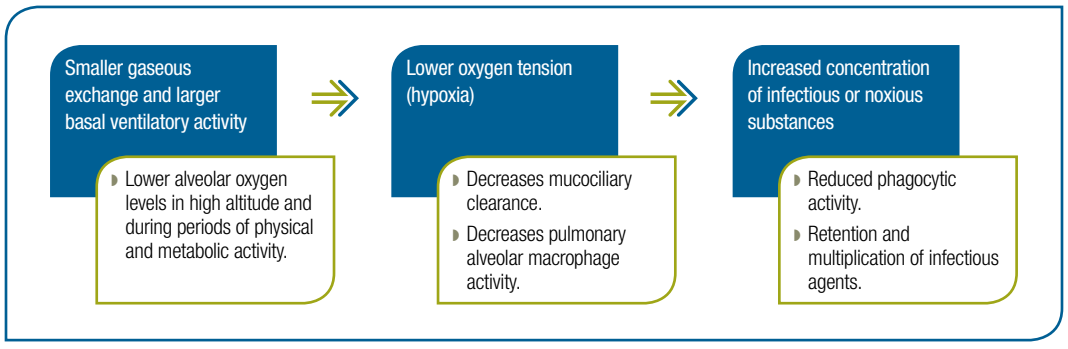

Figure 1. Anatomical and physiological features owing to a relative predisposition of the bovine lung to developing BRDC. The higher degree of the compartmentalization, leading to microenvironments of hypoxic and occluded airways, lead to a predisposition for pulmonary lesions typical of BRDC. [3]

Types of disease

Broadly defined, respiratory disease would include any process causing pathology to the respiratory system. In cattle there are many diseases that can induce respiratory system pathology including acute interstitial pneumonia (also termed atypical interstitial pneumonia), lungworms, aspiration pneumonia, calf diphtheria, etc. Additionally, BRDC has many synonyms that further confuse the situation including shipping fever, pasteurellosis, pneumonia, bronchopneumonia, and fibrous pleuropneumonia, among others. However, the context referred to as BRDC is a pneumonia, acute or chronic, caused by an infectious agent with associated inflammation (often suppurative and fibrous).

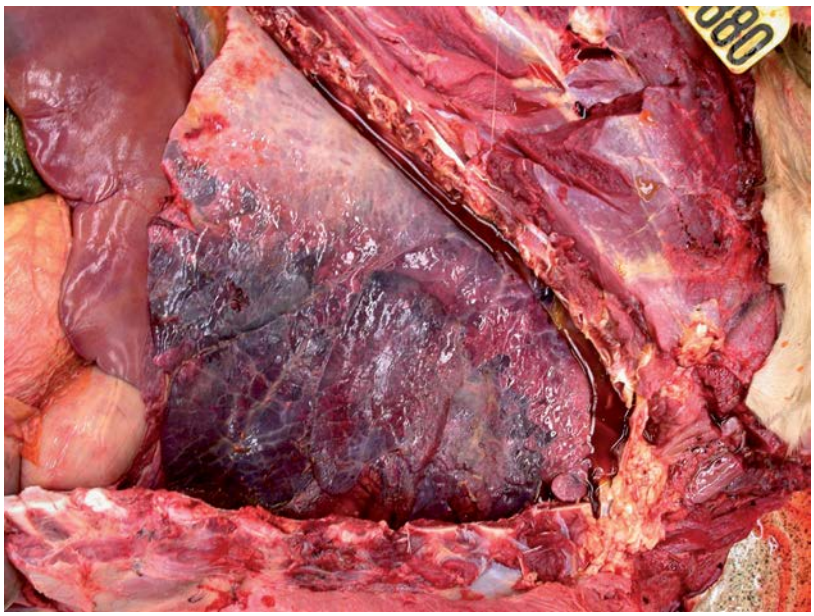

Figure 2. Severe, advanced lung lesions in a calf that succumbed to BRDC. The ventral lung fields are severely consolidated, with only a small (caudal and dorsal) portion of lung remaining. Also noticeable are areas of fibrin (hazy white on surface) accumulation.

2 Aetiology

As previously detailed, the contemporary cascade leading to BRDC is a mixture of stressors leading to immunosuppression, followed by a viral invasion of the upper and lower respiratory tract (URT/LRT) leading to further immunosuppression and mucosal injury, with subsequent bacterial infection.[4-6] The most common viruses and bacteria implicated in this cascade are the focus of this chapter.

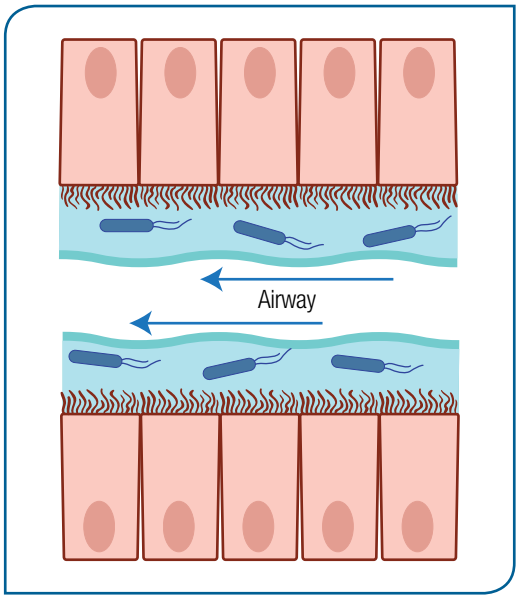

Figure 3. The mucociliary tree lines the airways and normally clears particles and pathogens from the airways using a "lift" effect by pushing them out of the airways and out of the body via mucous.

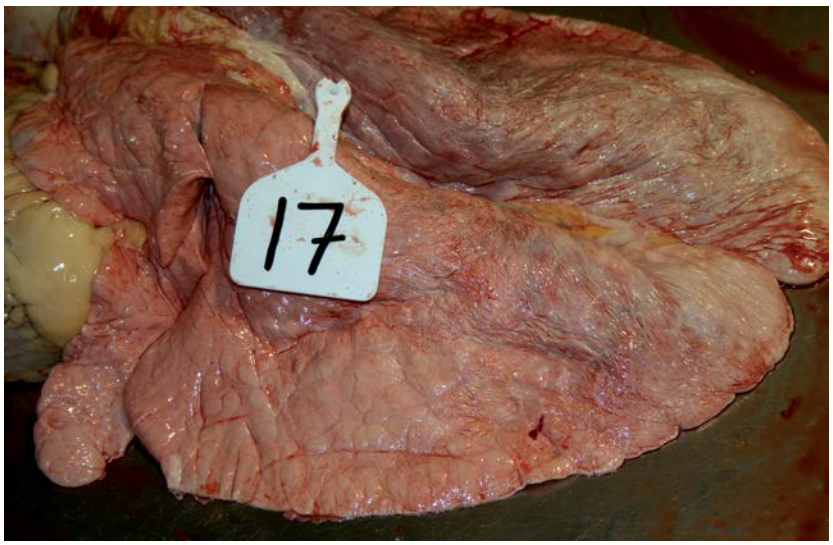

Figure 4. Normal lungs, no pathology present. Notice the healthy pink colour and how the lung is collapsed and spongy in appearance and feel.

Common viral agents

General viral pathogenesis includes damage to the mucosal lining, induced immunosuppression, decreased mucociliary clearance, depressed phagocytic activity, and phagocytic cell death.[5, 7] The decreased immune function and build-up of fluid and cellular debris in the airways produce an excellent medium for bacterial cell proliferation.

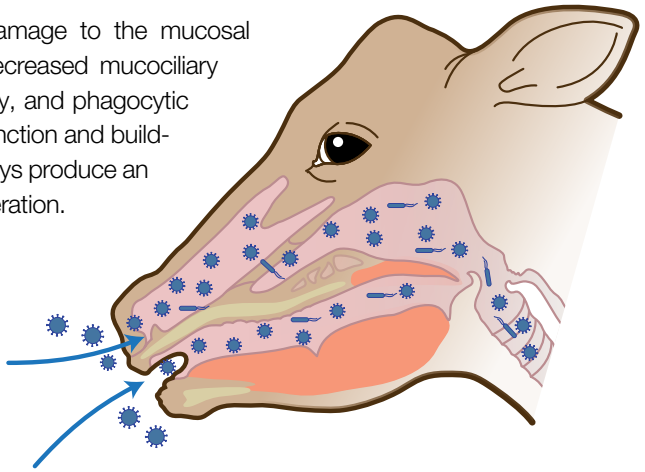

Figure 5. Viruses enter via the nose/mouth and damage the mucosa, decreasing mucociliary clearance and causing generalized immunosuppression. Bacteria are inhaled from the URT into the LRT and proliferate.

Bovine diarrhoea virus (BVDV)

BVDV has been extensively studied and many experiments have shown that BVDV works in synergy with other pathogens and exacerbates lesions of BRDC.[8, 9] BVDV is one of the most immunosuppressive viruses, but alone is generally not a primary cause of BRDC and does not cause specific lesions.[10] However, calves infected *in utero* with non-cytopathic strains between 40-125 days of gestation become carriers of the virus (persistent infection) and shed it in large numbers throughout their lives. These persistently infected cattle are much more likely to die from BVDV than those with acute infection. However, they can maintain a healthy status which makes them difficult to identify without diagnostic testing.

Bovine respiratory syncytial virus (BRSV)

Infections from BRSV occur primarily in young naïve beef and dairy calves, and can result in severe respiratory disease. Pyrexia, anorexia, increased respiratory rate, cough, nasal and lacrimal discharge, and dyspnoea (e.g. open-mouthed breathing) are all clinical signs associated with BRSV. BRSV has a greater potential for lethal respiratory disease as a lone pathogen than the other viruses of BRDC. Necropsy lesions include moderate cranioventral, red consolidation with a lobular pattern and emphysematous caudodorsal lung fields. [10]

Figure 6. Lesions typical of BRSV: cranioventral, red consolidation with a lobular pattern; severe cases will display emphysema of the caudodorsal lung.

Bovine herpes virus (BHV)

BHV type 1 is the causative agent of infectious bovine rhinotracheitis which typically causes pyrexia, anorexia, coughing, salivation, nasal discharge, conjunctivitis, inflamed nares, and dyspnoea if the larynx becomes occluded with purulent material. [10] The distinguishing characteristic of all herpes viruses; it establishes a latent infection in the trigeminal ganglion and can recrudesce in times of stress. However, disease is typically mild and self-limiting if not accompanied by other viral or bacterial pathogens.

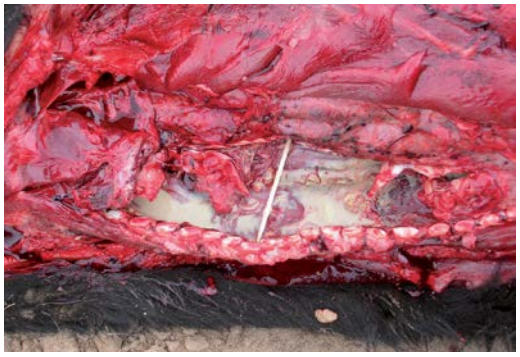

Figure 7. Characteristic lesion of BHV-1: severe mucopurulent and fibrinous tracheitis.

Parainfluenza virus-3 (PI3)

On rare occasions, PI3 can cause severe respiratory disease, but most infections result in a very mild disease of little concern. In naïve cattle or co-infection, the virus can cause a rhinitis with mucopurulent exudate in the nares and experimentally induced infection can cause atelectasis and consolidation. [10]

Bovine respiratory coronavirus (BRCV)

Reports of outbreaks caused by BRCV infections have been reported, but a direct link between viral infection and causation of disease has not been established. [11]

Common bacterial agents

Bacteria are considered to be secondary invaders subsequent to viral invasion, but can also be primary pathologic agents. [10] The bacteria implicated in BRDC are normal inhabitants of the URT and gain access to the LRT via inhalation of droplets or biofilms. [10, 12, 13] The majority of the damage done to the lungs is from the bacterial component of the infection and the ensuing inflammation.

Mannheimia haemolytica (MH)

- MH is considered by many to be the primary bacterial pathogen associated with BRDC. It is a gram-negative, facultative anaerobic bacterium. [7] MH is a commensal bacterium, but has been shown to directly cause lesions and death by inoculation into the lungs and thoracic cavity. [7]
- In the past, classification schemes, such as serotyping, have been used to differentiate strains of MH. However, DNA sequencing techniques might soon replace these methods and are allowing researchers to group MH in more specific subtypes which may allow great advancement in understanding the spread of bacteria within and between cattle populations. [14]

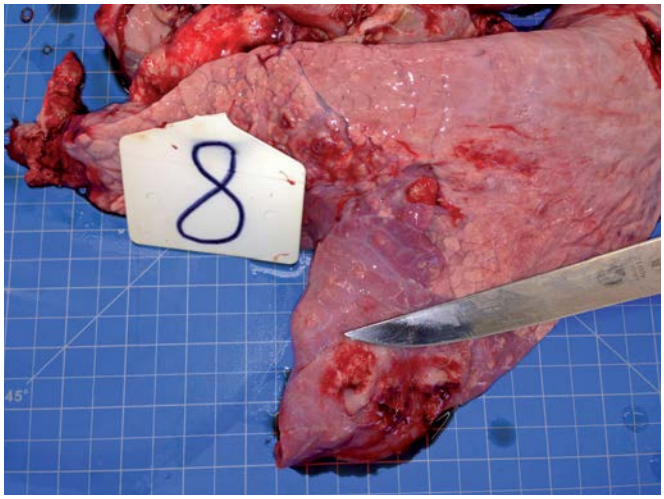

Figure 8. Cranioventral pneumonia with consolidation; dark cherry red lesions are considered by some to be a trademark of MH. This calf was euthanized 7 days after experimental infection with pure MH culture.

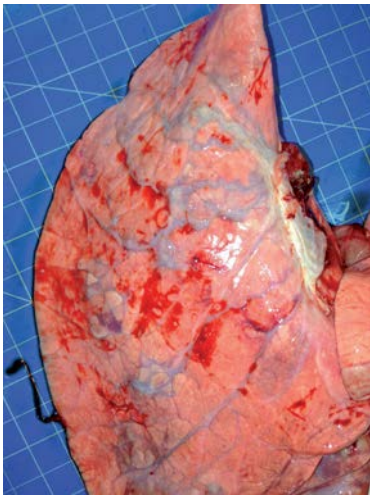

Figure 9. Another MH experimental infection showing interlobular pattern due to oedema that is often present on necropsy.

Pasteurella multocida (PM)

PM is a gram-negative commensal bacterium of the bovine URT and is commonly cultured from the nares and nasopharyngeal swabs in healthy cattle.[7] It is traditionally considered to be of less importance in BRDC as compared to MH. However, the isolation of PM from cases of BRDC are becoming more common place[7, 15] and some publications even cite PM as the most important BRDC pathogen.[16]

Histophilus somni (HS)

HS is a gram-negative commensal bacterium of the bovine URT, but may preferentially colonize the LRT.[7] HS is associated with BRDC, but can also cause a variety of other pathological processes such as septicaemia, synovitis, thrombotic meningoencephalomyelitis (TEME), fibrinous pericarditis, and sudden death associated with left ventricular papillary muscle necrosis.[5, 15] The reported prevalence of HS in samples of BRDC specimens varies, but its detection in field cases is typically lower than that of MH and PM, partially due to it being a more fastidious organism to culture.

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