PNEUMONIA - BOVINE RESPIRATORY DISEASE -(BRD)

Pneumonia. Bronchial pneumonia. Fibrinous pleuropneumonia. Shipping fever. All of these terms describe the same costly disease: **Bovine Respiratory Disease complex, or BRD.**

BRD a major cause of economic losses to the Dairy Industry. Depending on the organism(s) involved, death from BRD can occur within 24 to 36 hours of symptoms appearing, or the infection can become chronic, not causing death but instead producing widespread, permanent lung damage. Once the disease has progressed to the point that fibrosis, adhesions and/or abscesses have developed in or around the lungs, no treatment will satisfactorily correct the problem. The animal may survive, but it will always carry some residual lung problems that will impact performance. That is why early recognition and treatment of BRD are so important.

CAUSES

BRD is defined as a "disease complex" for two reasons:

1. It usually is caused by a variety of pathogens, both viral and bacterial, that interact with one another to produce full disease, and
2. The behaviour of these pathogens follows a sequential process that, step by step, results in sick animals.

Bacterial pathogens apparently cause the acute syndrome by invading the bovine respiratory tract that has been compromised by viral infections. Preceding and contributing to the infection is the stress of weaning, change of feed and variations in ambient temperature and humidity, all of which tend to reduce energy reserves.

Several species of bacteria have been isolated, but the most commonly found species are *Mannheimia haemolytica*. (formerly known as *Pasteurella haemolytica*), *P. multocida, Histophilus (Haemophilus) somnus*and
- *Mycoplasma* spp. **From all observations and experimental evidence, *M haemolytica*. *(P. haemolytica)* and *P. multocida* are the most important bacteria involved in BRD.**
Viruses such as Infectious Bovine Rhinotracheitis (IBR), Bovine Viral Diarrhoea Virus (BVDV), Bovine Respiratory Syncytial Virus (BRSV) and Parainfluenza Virus 3 (PI3) may also be involved in the BRD complex, often opening the door to secondary bacterial infections.

PATHOGENESIS

Pulmonary defense mechanisms Under normal conditions the major airways and the lung parenchyma prevent the entry of and neutralize or remove injurious agents, so that the lung contains very few, if any, organisms beyond the large airways.

Many infections of the respiratory tract originate from aerosolized particles carrying infectious agents that arise external to or within the respiratory tract.
In order to induce an infection by the aerosol route, **an etiological agent must be aerosolized, survive in the aerosol, be deposited at a vulnerable site in the respiratory tract of a susceptible host, and then multiply.** Thus the pathogenesis of these respiratory infections is related to the deposition of particles and infectious agents within the respiratory tract.
Under normal conditions a complex of biochemical, physiological and immunological defense mechanisms protects the respiratory tract from inhaled particles that could be injurious or infectious. **The major defense mechanisms of the respiratory tract include:**

-1-AerodynamiC filtration by the nasal cavities
Sneezing
Local nasal antibody
The laryngeal reflex
The cough reflex
Mucociliary transport mechanisms
Alveolar macrophages
Systemic and local antibody systems.

Most of the research on defense mechanisms has been done in man and in laboratory animals.
-Respiratory mucociliary clearance The mucociliary escalator has important functions in the lung's physical defenses against the constant challenge of inhaled pathogens.
- By various physical mechanisms, mucus traps and subsequently transports inhaled particles to the pharynx, where they are normally swallowed.
-Mucus also protects the airways by absorbing inhaled chemicals and gases, by humidifying the inspired air and by keeping the underlying mucosa hydrated.
-Mucus contains antibodies, especially IgA, which together with lactoferrin and lysozyme provide immunological defense.
-Airway secretions consist of two layers. An underlying liquid layer, known **as the periciliary fluid**, in which the cilia beat, originates largely from transepithelial osmosis.
- An overlying gel or mucus layer is composed of intertwined mucin strands.
Airway mucus is secreted in small globules, which expand several Hundred fold within seconds and are later drawn into strands and transported

rostrally by ciliary activity.
-The secretion of respiratory mucus is a protective mechanism by which inhaled particles touching the airway mucosa stimulate local mucus production, which then traps and transports the particle from the lung.
-Airway mucus is produced mainly by submucosal glands and goblet cells, also known as mucus-producing cells.
-Airway secretions also contain alveolar fluid, surfactant and alveolar cells, including macrophages, which are drawn into the mucociliary ladder by surface tension.
-**Airway mucus is a complex substance consisting of 95% water and a 5% combination of glycoproteins, proteoglycans, lipids, carbohydrates and minerals. Mucin is the main nonaqueous component.**
Effective mucociliary clearance or mucokinesis can occur over a range of mucus viscosity but very-low-viscosity mucus is poorly transported
and tends to gravitate toward the alveoli, while excessively viscous mucus, which is also poorly transported, may lodge in the airways and become inspissated.
-In respiratory disease mucociliary clearance is impaired through disruption of effective ciliary activity, or changes in the quantity or quality of the mucus or periciliilry fluid, or all three factors.
In viral pulmonary disease, ciliary activity can be disrupted because of temporary deciliation or lesions of the respiratory mucosa. The defective mucociliary clearance may also last for several weeks.

Large increases in the glycoprotein content of mucus also occur, which affects the mucokinetic properties. Purulent respiratory secretions have reduced elasticity and together with the increased viscosity affect the mucociliary clearance.
Acute inflammation also results in the production of serum proteins from the airway exudate, which alters the viscoelasticity of mucus and further reduces mucokinesis.
Yellow or green respiratory secretions are due to the enzyme myeloperoxidase, released from leukocytes in the static secretion, or to high numbers of eosinophils.
The quantity of mucus increases in most cases of respiratory disease as a result of stimulation of goblet cells and submucosal glands by inflammatory mediators.

Cough reflex
The cough reflex provides an important mechanism by which excess secretions

and inflammatory exudates from the lungs and major airways can be removed from the airways and disposed of by expectoration or swallowing. In animals with relatively normal lungs, coughing represents a very effective means of expelling inhaled foreign bodies, or excessive or abnormal respiratory secretions, down to the level of the fourth- or fifth -generation bronchi. If the airways become deciliated, the cough reflex is the main and only mucus-clearance mechanism remaining.

- **Cattle have a small physiological gaseous exchange capacity and greater resultant basal ventilator activity**. The small gaseous exchange capacity may predispose cattle to low bronchiolar or alveolar oxygen levels during exposure to high altitudes and during periods of active physical or metabolic activity. During these times, low oxygen tension or hypoxia may slow mucociliary and alveolar macrophage activity and decrease pulmonary clearance rates.

-The basal ventilatory activity is comparatively greater than other mammals, which results in the inspired air becoming progressively more contaminated with infectious, allergenic or noxious substances.

CLINICAL SIGNS AND DIAGNOSIS

BRD manifests in numerous ways in dairy cattle, depending on the age of the animal, causative organism(s) and stage of the disease, among other factors. While identifying sick dairy cows is not an exact science, producers should be trained to watch for these early clinical signs:

- **Fever.**The connection between BRD and fever is extremely strong. BRD is one of the most common causes of fever - and fever is one of the earliest signs of the BRD complex.
- **Depression.** Affected animals hang their heads, look lethargic and often stand away from other cattle.
- **Inappetence.** An animal's unwillingness to eat is tied closely to fever and depression. A "floppy" belly, caused by a shortage of fiber in the digestive tract, is an early sign of in appetence.
- **Serous nasal and eye discharge.** One of the earliest indicators of BRD, this form of discharge is watery, sticky and clear. Serous discharge usually starts from the nose, then moves to the eyes as the disease progresses.
- **Purulent nasal discharge.** An indicator of more advanced BRD, this discharge is thick, cloudy and pus-filled. The cloudy appearance is caused by white blood cells that have localized in the respiratory tract to attack the infection.
- nasal discharge may or may not be present, depending upon the amount of
- exudate present in the bronchioles and whether or not there is accompanying
- inflammation of the upper respiratory tract.

- **Bloody nasal discharge.** Also in acute BRD cases, blood may appear in the nasal discharge due to irritation in the respiratory tract. The protective mucosal lining is broken down and enters the respiratory system, where it is blown out.
- **Stiff gait.** Sick animals may experience muscle and joint soreness due to an increased systemic endotoxin load,
- **Crusty muzzle.** Because it is not feeling good, the animal will tend to lick its hair and muzzle less and generally take poorer care of itself. At the same time, mild dehydration will cause a drying of membranes around the mouth, adding to the dry, crusty appearance.
- **Salivation.** Again, the animal's overall feeling of malaise may cause it to drool and gape more than usual.
- **Mild diarrhoea.** Endotoxins in the animal's system cause displacement of body fluids, dumping more fluid into the bowel and disrupting normal absorption of food, causing loose stools.
- **Rapid, shallow breathing.** More blood is distributed to the infected portion of the lungs, causing occlusion of airflow. The animal has to breathe harder to get good air exchange, because parts of its lungs are not working properly. Early morning, when environmental influences are less, is the best time to evaluate breathing. Increased respiration when the environmental temperature is high may be caused more by the external environment than disease. On the other hand, a calf breathing 60 breaths per minute at 5 a.m. when the ambient temperature is low is truly ill.
- **Soft coughing.** In early BRD cases, the lungs and airways are generally painful, so the animal will try to clear the airway with mild, tentative coughing. Loud, prominent coughing or "honking" indicates far more chronic, advanced cases, at which point treatment is difficult.
- the type of cough varying with the nature of the lesion.
- Bacterial bronchopneumonia is usually accompanied by a moist and painful cough.
- In viral interstitial pneumonia the coughing is frequent, dry and hacking,often in paroxysms.
- Cyanosis is not a common sign and occurs only when large areas of the lung are affected. A
- In the advanced stages, severe dyspnea with an expiratory grunt are common.
- In viral interstitial pneumonia, affected animals are usually not toxemic but they may have a fever and be inappetent or anorexic. However, some cases of viral interstitial pneumonia can be diffuse and severe and cause severe respiratory distress, failure to respond to therapy and death within a few days.
- -Viral infections are also introduced chiefly by inhalation and cause a primary bronchiolitis, but there is an absence of the acute inflammatory reaction that occurs in bacterial pneumonia.
- -Spread to the alveoli causes enlargement and proliferation of the alveolar epithelial cells and the development of alveolar edema.
- -Consolidation of the affected tissue results but again there is an absence of acute inflammation and tissue necrosis so that toxemia is not a characteristic development.

- When complete consolidation occurs in either form, loud breath sounds are the most obvious sound audible over the affected lung but crackles may be heard at the periphery of the affected area in bronchopneumonia. Consolidation also causes increased audibility of the heart sounds.
- When pleurisy is also present a pleuritic friction rub may be audible in the early stages, and muffling of the breath sounds over the ventral aspects of the lungs in the late exudative stages. If a pleural effusion is present, percussion of the thorax will reveal dullness of the ventral aspects .

CLIN ICAL PATHOLOGY

Respiratory secretions The laboratory examination of the exudates and secretions of the respiratory tract is the most common diagnostic procedure performed when presented with cases of pneumonia.

-Nasal swabs, tracheobronchial aspirates and bronchoalveolar lavage samples can be submitted for isolation of viruses, bacteria and fungi, cytological examination and determination of antimicrobial sensitivity.

Hematology

Hematological examination can indicate if the infection is bacterial or viral in nature and its severity.

-The hematocrit will be elevated in severely toxemic animals that are not drinking water. Severe bacterial bronchopneumonia and pleuritis is characterized by marked changes in the leukon. Serum fibrinogen concentrations are markedly elevated in horses with pleuropneumonia and pleuritis.

- Some limited studies indicate that the measurement of acute-phase proteins in bovine respiratory disease may be a valuable diagnostic and prognostic aid.

- **Fecal samples**

When lungwonn pneumonia is suspected, fecal samples can be submitted for detection of the larvae.

- **NECROPSY FINDINGS**

Gross lesions are usually observed in the anterior and dependent parts of the lobes;even in fatal cases where much of the lung is destroyed, the dorsal parts of the lobes may be unaffected.

The gross lesions vary a great deal depending upon the type of pneumonia present.

Bronchopneumonia is characterized by the presence of serofibrinous or purulent exudate in the bronchioles, and lobular congestion or hepatization.

In the more severe, fibrinous forms of pneumonia there is gelatinous exudation in the interlobular septae and an acute pleurisy, with shreds of fibrin present between the lobes.

In interstitial pneumonia the bronchioles are clean and the affected lung is sunken, dark red in color and has a granular appearance under the pleura and on the cut surface.

MANAGEMENT

There is no miracle answer to effectively managing BRD. Because it's a disease complex, determining the right treatment for each individual case is a complex process as well.

When addressing a severe BRD challenge, here are a few evaluation tools to help you improve how you manage the disease complex:

1. **Identifying fever.** To catch fevers in freshly calved dairy cows, taking temperatures for the first 10 days post-calving is recommended. The first 10 days post-calving have the highest percentage of fevers. The cow is under high stress, including giving a lot of her own immune defenses to her calf in the colostrum.
2. When checking these Cows, it is recommended to take temperatures in the early morning to avoid elevations solely due to high ambient temperatures.
3. **Complete blood count (CBC).** Blood is a window into the body. A CBC on one or a handful of cows can be helpful in determining to what stage the disease has progressed, and sometimes what main, causative organisms are involved.

Differential Diagnosid

• Diseases of other body systems may cause polypnea and dyspnea.

-Congestive heart failure

,- the terminal stages of anemia,

- poisoning by histotoxic agents such as hydrocyanic acid,

-hyperthermia and

-acidosis are accompanied by respiratory embarrassment but not by the abnormal sounds typical of pulmonary involvement.

TREATMENT

There are a number of injectable antibiotics available for treating pneumonia and reducing fever caused by BRD infections

isolation of affected animals and careful surveillance of the remainder of the group to detect cases in the early stages should accompany the administration of specific antimicrobials to affected animals.

- Antimicrobial therapy In specific bacterial infections as listed above,

-The choice of antimicrobial will depend on the tentative diagnosis, the experience with the drug in previous cases and the results of drug sensitivity tests.

-Animals with severe pneumonia will require daily treatment for several days until recovery occurs. Those with bacterial pneumonia and toxemia must be treated early, on an There are two major difficulties in the clinical diagnosis of pneumonia. The first is to decide that the animal has pneumonia; the second is to determine the nature of the pneumonia and its cause.

Antimicrobials for treatment of lung disease are preferably those that achieve therapeutic concentrations in diseased lung tissue after administration of conventional doses.

This has been convincingly demonstrated for the macrolide

(azithromycin, erythromycin), triamilide (tulathromycin) and fluoro quinolone

(danofloxacin, enrofloxacin) antimicrobials and fluorfenicol in a variety of species.

The beta-lactam antimicrobials (penicillin, ceftiofur) are effective in

treatment of pneumonia in horses, pigs and ruminants despite having chemical properties that do not favor their accumulation in lung tissue.

Routes of administration include oral (either individually or in medicated feed or water), parenteral (subcutaneous, intramuscular, intravenous), or inhalational.

Aerosolization and inhalation of antimicrobials has the theoretic advantage of targeting therapy to the lungs and minimizing systemic exposure to the drug. However, while administration by inhalation achieves good concentrations of drug in bronchial lining fluid, the drug does not penetrate unventilated regions of the lungs, in which case parenteral or oral administration of antimicrobials is indicated.

Administration of gentamicin to horses and ceftiofur sodium to calves with pneumonia has been investigated.

Aerosol administration of gentamicin to normal horses results in gentamicin concentrations in bronchial lavage fluid 12 times that achieved after intravenous administrati on Aerosolized ceftiofur sodium (1 mg/kg) is superior to intramuscular adminishation in treatment of calves with

M. izacmolytica ,

-treatment of parasitic lung disease, such as that caused by migrating larvae or lung worms, is by administration of appropriate anthelmintics as ivermectin.

- The common causes for failure to respond favorably to treatment for bacterial pneumonia include:

- Advanced disease when treatment was undertaken

- Presence of pleuritis and pulmonary abscesses " Drug-resistant bacteria

- Inadequate dosage of drug

- Presence of other lesions or diseases which do not respond to antimicrobials.

There is no specific treatment for the viral pneumonias and while many of the Mycop lasma spp. are sensitive to antimicrobials in vitro, the pneumonias associated with them do not respond favorably to treatment. This may be due to the intracellular location of the Mycoplasma making them inaccessible to the drugs.

Because viral and mycoplasmal pneumonias are commonly complicated by secondary bacterial infections, it is common practice to treat acute viral and mycoplasmal pneumonias with antimicrobials until recovery is apparent.

- Other drugs Nonsteroidal anti-inflammatory drugs are useful in the treatment of infectious respiratory disease of cattle and horses, and likely other species. The drugs act by inhibiting the inflammatory response induced by the infecting organism and tissue necrosis.

- **Meloxicam** (0.5 mg/kg subcutaneously, once), when administered with tetracycline, improves weight gain and reduces the size of lesions in lungs of cattle with bovine respiratory disease complex over those of animals treated with tetracycline alone.

- **NSAIDs also improve the clinical signs of cattle with respiratory disease.**

- Bronchodilators have been investigated in the treatment of pneumonia in food animals. **These drugs also enhance mucociliary clearance of material from the lungs.** Most administration is orally or by inhalation.

-**Theophylline has been evaluated as a bronchodilator** to relieve respiratory distress in cattle with pneumoni a. When it was given orally at a dose of 28 mg/kg BW daily for 3 days, along with antimicrobial therapy, to calves with naturally acquired respiratory disease,

- **Supportive therapy** and housing Affected animals should be housed in warm, well-ventilated, provided with ample fresh water and light, nourishing food.

- If the animal does not eat, **oral or parenteral force-feeding should be instituted.** If fluids are given intravenously care should be exercised over the speed with which they are administered. Injection at too rapid a rate may cause overloading of the right ventricle and death due to acute heart failure.

-Supportive treatment may include the provision of oxygen, if it is available,especially in the critical stages when hypoxia is severe.