Role of Parainfluenza-3 in Cattle

C. GALE

Eli Lilly and Company, Greenfield, Indiana 46140

The occurrence of Myxovirus parainfluenza-3 (PI-3) in cattle has been well documented (1, 2, 11, 13, 18, 20, 28). This organism plays an important role in the bovine respiratory complex. Current investigations indicate that respiratory diseases of cattle are due to the interactions of viruses, bacteria, and other factors.

To date, the viruses isolated in the United States and throughout the world appear related. Some minor strain differences in immunodiffusion reactions have been observed; however, all the viruses reported have been related by cross neutralization and hemagglutination inhibition tests (23, 27). That only a single homotypic virus has been found is favorable for development of vaccines.

Parainfluenza-3 virus has been isolated from aborted fetuses (29), from milk (22), and from the testicles of an infertile bull (9). Since PI-3 virus can be involved in abortion and its occurrence in milk, its consideration as a pathogen in dairy cattle is necessary.

Epizootiology

Among the viral agents now known to be associated with respiratory diseases of cattle, Myxovirus parainfluenza-3 is one of the more important. This virus is widely distributed and results in a spectrum of clinical disease varying from subclinical to severe respiratory distress (2, 12, 16, 20, 28, 33).

Antibodies to PI-3 have been reported in cattle in Canada (20), most European countries, and many of the Asiatic nations (22). A survey of a cattle population in Nebraska (24) reported over 86%, and in New York 48% (21) of the cattle sampled had PI-3 antibodies.

In many respects the disease resembles influenza and parainfluenza in man. The severity of the disease may vary according to stress factors and secondary bacterial invaders, and the relative times the different agents become involved. In the fall of the year there is an increase in the number of cases, an increase in PI-3 antibody levels, and in the number of isolates of the virus (33).

Parainfluenza-3 may act as a triggering mechanism for other bacterial or viral agents present in the respiratory tract (17). It has been suggested that the virus multiplies in the respiratory mucosa, which it alters in some
manner, allowing other agents to invade.

Experimentally, it has been necessary to utilize the PI-3 virus plus stress and pasteurella to simulate the shipping fever complex in normal calves. This type of interaction of various etiologic agents and environmental factors in respiratory disease has been reported by many workers. Pneumonic lesions produced in colostrum-deprived calves with PI-3 virus alone have been reported (2, 34). The virus has been isolated from lesions of natural cases of pneumonia with no complicating bacteria (20).

When infectious bovine rhinotracheitis (IBR) and bovine virus diarrhea (BVD) are given along with PI-3 virus, a more severe reaction occurs. The widespread occurrence of the PI-3 virus and the demonstration of shedding of BVD virus by convalescent cattle and intermittent shedding of IBR virus present the opportunity for such complications in the field.

The presence of pasteurella has been demonstrated to cause a more severe respiratory involvement with PI-3 and is further evidence that PI-3 virus in the nasal tract of cattle cannot be ignored (5). In fact, pasteurella organisms have been shown to occur in greater frequency in cattle with clinical signs of shipping fever than in normal cattle. In one study pasteurellae were isolated from 3% of the normal calves, 59.6% of calves with abnormal respiratory signs, and 39.4% of convalescent calves (19).

The presence of other disease conditions in other anatomical locations may act synergistically with respiratory disease to produce a more serious problem than either produces alone. In very young calves the digestive system is frequently involved and may be a secondary factor or become of primary importance in the final outcome of a disease. Parainfluenza-3 has been reported associated with pneumoenteritis in calves (15).

The role of other viruses, such as rhinoviruses, reoviruses, and adenoviruses, has not been differentiated, and further work is necessary to demonstrate their role in the disease complex (3, 6, 25). The presence of mycoplasma in the respiratory tract needs further definition as to its role in this disease (14).

Pathologic Changes

Pathology varies greatly, depending upon the amount of secondary involvement. The typical lesions of field and experimentally produced diseases are organization of the apical and cardiac lobes (8, 20, 26). Histological examination generally reveals bronchoelitis, alveolitis, edema, and cellular exudate in the lungs. Acidophilic intracytoplasmic inclusion bodies have been demonstrated in nasal and bronchial epithelium. In pneumonia associated with Pasteurella sp., there is greater consolidation and infiltration, with more extensive cellular infiltration, with loss of alveolar structure and evidence of abscessation.

Prevention and Control

Prevention is the best procedure to follow in controlling respiratory problems. This involves management, prophylactic medication, and immunization. Only the role that immunization plays will be considered, since a discussion of the two other areas is too broad in scope to undertake here. Respiratory problems in the field are seldom uncomplicated and, therefore, a good preventive program will include IBR, PI-3 and Pasteurella multocida and Pasteurella hemolytica. The choice of modified live vaccine or a killed antigen will be dictated by the situation. Modified live virus vaccines are contraindicated in pregnant animals, in view of possible abortion. If these vaccines are used on premises where pregnant animals are present, adequate isolation should be provided.

Cattle should be vaccinated before exposure, allowing sufficient time for immunity to develop. In killed antigens, two vaccinations are recommended for adequate protection. Live or attenuated vaccines usually show a more rapid response but also must be given before exposure to disease.

Immunity to respiratory diseases may involve several mechanisms (10, 30, 32). Evidence indicates that local immunity in the respiratory tract may play an important role in complete immunity (30, 32). Studies have demonstrated lower respiration incidence or less severe disease, or both, when antibodies are present in the serum before infection (4, 26). The ability of PI-3 virus to infect cattle in spite of circulating antibody, parallels the situation of PI-3 in man (4, 26). The presence of PI-3 antibodies, however, reduced the severity of disease and frequency of the virus isolation. As an example, children with human PI-3 antibodies were less apt to develop fever and had less respiratory tract involvement (4).

These findings are supported by experimental calfhood vaccination studies with a killed PI-3 virus vaccine plus P. multocida and P. hemolytica (26). After experimental challenge, temperatures were higher and persisted longer in unvaccinated animals. The differences were significant at the 0.01 or 0.05 probability levels between post-challenge Days 3 and 6 (Fig. 1).

In these experiments the rate of virus shed-
Fig. 1. Pyrexia following challenge in vaccinates and controls.

Significant differences between groups
*Probability level = 0.01
**Probability level = 0.05

Table 1. Gross signs of pneumonia between vaccinates and controls.

<table>
<thead>
<tr>
<th>Lungs</th>
<th>Vaccinates</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>13 of 17</td>
<td>5 of 14</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>4 of 17</td>
<td>9 of 14</td>
</tr>
<tr>
<td>(1 of 17 Severe)</td>
<td>(4 of 14 Severe)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Results of microscopic lung examinations.

<table>
<thead>
<tr>
<th>Changes</th>
<th>Vaccinates</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal to mild</td>
<td>14 of 17, 82%</td>
<td>6 of 13, 46%</td>
</tr>
<tr>
<td>Severe</td>
<td>3 of 17, 18%</td>
<td>7 of 13, 54%</td>
</tr>
</tbody>
</table>

Table 3. Clinical cases of shipping fever.

<table>
<thead>
<tr>
<th></th>
<th>Vaccinates</th>
<th>Non-vaccinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number requiring treatment</td>
<td>4 of 60</td>
<td>22 of 60</td>
</tr>
<tr>
<td>Per cent requiring treatment</td>
<td>6.6</td>
<td>36.6</td>
</tr>
<tr>
<td>Number died</td>
<td>0</td>
<td>2</td>
</tr>
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</table>

Table 4. Myxovirus parainfluenza-3 virus isolations.

<table>
<thead>
<tr>
<th></th>
<th>Vaccinates</th>
<th>Non-vaccinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of isolations</td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td>Number of attempts</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Per cent isolated</td>
<td>5</td>
<td>38.3</td>
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disease status in a herd. Because of the similarity of signs of respiratory diseases, a differential diagnosis may be necessary using laboratory procedures. The information obtained can then be used in planning future preventive and control programs. Further research is needed to gain more knowledge to fully evaluate the bovine respiratory disease complex and immunological methods of protection.

References


Field Use of Bovine Vaccines

There is ample evidence that at least 3 bovine viruses occur commonly in cattle populations in the United States, and each is capable of producing a disease syndrome. The severity of the disease produced will vary with each virus and is described as follows:

Infectious bovine rhinotracheitis (IBR) is a respiratory disease characterized by inflammation, edema, hemorrhage and necrosis of the respiratory passages. Other clinical manifestations, including pustular vulvo-vaginitis, conjunctivitis, abortions, and encephalitis are caused by IBR virus.

Bovine virus diarrhea (BVD) is a widespread contagious disease of cattle causing a variety of clinical signs, including mild or inapparent, acute and chronic forms. The disease affects primarily the digestive tract, causing congestion, hemorrhage, edema, and erosions of the oral mucosa and other areas of the gastrointestinal tract. Laminitis with a resulting lameness is another symptom often observed with BVD.

Bovine parainfluenza (PI-3) is a widespread virus that produces a mild, transient respiratory disease in susceptible cattle. When the virus is combined with certain bacterial organisms such as pasteurella and under conditions of stress, more severe symptoms may be produced.

Other bovine viruses have been isolated from cattle, including rhinoviruses, reoviruses, adenoviruses and enteroviruses; but to this date, there is no concrete evidence that they cause significant economic losses in the United States.

Commercial Vaccines Available

Vaccines have been developed for IBR, BVD and PI-3, and commercial products are available in either single or multiple vaccine form. The vaccines have been shown safe and effective in both laboratory and field tests, which will be discussed in more detail.

Two types of cattle operations in which the vaccines may be used should be mentioned. In a beef operation, often large numbers of range cattle, highly susceptible to disease, are assembled and shipped to a feed lot for finishing. It is difficult to vaccinate these cattle before collection. Consequently, they are vaccinated at the collection point or at the feed lot. During this operation, they are usually stressed by changes of feeding, weather, water intake, ventilation, and crowding, and exposed to a variety of infectious agents which may cause the cattle to sicken. It is not the ideal time or place to vaccinate.

Dairy operations are different and actually much more suitable for successful use of vaccines. Calves are more available for vaccination, generally better isolated, and subjected to less stress than are beef cattle. Calves in dairy operations may also be vaccinated at a more nearly ideal age, thereby giving the vaccine a chance to "take."

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