factsheet

Pork Information Gateway

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Porcine pleuropneumonia (PPP) caused by *Actinobacillus pleuropneumoniae* (App)

Background

Porcine pleuropneumonia (PPP) caused by the Gram-negative bacteria Actinobacilluspleuropneumoniae (App) occurs throughout the world. It is rather well controlled in the United States and Canada, however PPP remains a major concern in many Latin-American, Asian and European countries.

Etiology and Epidemiology

App isolates are divided into 15 serotypes. The serotype is determined by the capsular polysaccharides and the cell wall lipopolysaccharides (LPS). Some serotypes have similar or identical LPS. This explains the cross-reactions observed in some immunoassays between serotypes 1, 9 and 11; serotypes 3, 6, 8 and 15; and serotypes 4 and 7. All serotypes except serotypes 9, 11 and 14 have been identified in North America. Untypable strains have also been reported. However, this can be due to inappropriate serotyping procedures. True, untypable strains either without capsular antigens or with unknown antigens exist, but they are rare.

The virulence of App isolates varies greatly. This results in a large spectrum of clinical situations including subclinical, acute and chronic infections. The basis for App virulence is not completely understood. Several true or putative virulence factors have been identified of which cytotoxins are among the most important. Four different APP toxins have been recognized to date. One toxin (ApxIV) is produced by all serotypes in vivo only and can be used for diagnostic purposes. The other toxins (ApxI, ApxII, and ApxIII) are produced in different combinations depending on the serotypes. Some of them are also produced by other *Pasteurellaceae* such as *Actinobacillussuis*. This explains why the immunoassays based on these toxins are not specific for App.

Interestingly, the virulence of an isolate correlates well with the serotype in a given area. In North America, serotypes 5, 7 and very rarely serotype 1 are the most frequently recovered from clinical cases, especially in conventional herds. Serotype 1 was the most frequently recovered serotype in North America in the 1980's and 1990's. Since then it has been almost completely eradicated. Serotypes 12, 6, 8 and 15 are considered intermediate in virulence and are usually recovered from clinically healthy animals or from clinical cases in high health status herds.

Conventional herds are frequently infected with more than one low or mildly virulent serotype. Some herds may be infected with virulent serotypes (such as serotypes 1, 5, or 7) without demonstrating any clinical signs or lesions at the slaughterhouse. However, most of these herds will experience occasional clinical outbreaks when the respiratory defense mechanisms are compromised by concurrent infections or inappropriate environmental conditions. In a given geographical region, the most prevalent serotypes (as demonstrated by serology) are frequently different from those recovered from diseased pigs.

Transmission of App between herds occurs mainly through the introduction of clinically healthy carrier animals. The main route of spread is by direct contact from pig to pig or by aerosol droplets transmitted over short distances. In acute outbreaks the organism appears to transmit by aerosol over longer distances within or even between buildings. Animal species other than pigs such as birds, rodents or insects have not been shown to serve as reservoirs or significant vectors of the organism. Survival in the environment is considered to be of short duration. However, when protected with mucus or other organic matter, App can survive for several days or weeks. This may explain why fomites and people are occasionally involved in transmission.

Infected sows can transmit the infection to their offspring. It has been suggested that only a few piglets get infected from their mother during the lactation period when the level of maternal immunity is usually high, and that these infected pigs spread the bacteria to other pigs after weaning, when passive immunity declines. The persistence of protective colostral antibodies in piglets may range from 2 to 10 weeks postpartum, depending on the initial level. Early weaning has been used with a relatively high level of success to produce App-free piglets from infected sows.

The prevalence of infection may vary greatly depending on the serotype. Some serotypes are highly contagious but poorly virulent (e.g., serotype 12, 6, 8 and 15) whereas the contrary is true for others (e.g., serotypes 1 and 5). This has to be taken into account when developing serological monitoring programs. Morbidity and mortality depend on the virulence of the strain and on the environment. Factors such as overcrowding and adverse environmental conditions may promote the development and spread of the disease. Co-infections with other respiratory pathogens may also increase clinical signs and mortality.

Clinical Signs and Lesions

In the acute form, many pigs in the same or different pens are affected. Body temperature rises to 105–106°F (40.5–41°C) and the skin may be reddened. Animals are depressed and reluctant to rise, eat, and drink. Severe respiratory signs including dyspnea, cough, epistaxis, and sometimes mouth breathing are evident. The course of the disease differs from animal to animal, depending on the extent of the lung lesions and the time of initiation of therapy. All stages of the disease from subacute to chronic and subclincal to fatal may be observed within an affected group.

In the chronic form, there is little or no fever, and a spontaneous or intermittent cough of varying intensity develops. Appetite may be reduced, and this may contribute to the decreased rate of gain in body weight. Affected animals can be identified by their intolerance of exercise. When forced to move they lag behind the group and struggle weakly when restrained.

The pneumonia may be unilateral or bilateral, with major involvement of the dorsal portion of the diaphragmatic lobes, where pneumonic lesions are often focal and well demarcated. Fibrinous pleurisy is present in animals which die in the acute stage of the disease. As the lesions age, the fibrinous pleurisy becomes fibrous and may adhere strongly to the parietal pleura. The uniform dark red or black color of the early lung lesion becomes lighter in color and remains firm in the worst-affected areas of the lung. The lesions shrink in size as resolution progresses, until in more chronic cases nodules of different sizes remain, mostly in the diaphragmatic lobes. In many cases the lung lesion resolves, and only a residual focus of adhesive fibrous pleurisy remains. However, a high prevalence of pleuritis at slaughter is suggestive of chronic pleuropneumonia. These lesions may be responsible for slaughter condemnations.

Diagnosis

Even if gross lesions are rather suggestive of PPP it is recommended to confirm the diagnosis through culture of the agent. Isolation from acute pneumonic lesions is relatively easy except if the animals have been recently treated with bactericidal antimicrobials or when large numbers of other bacteria such as *Pasteurellamultocida* are also present in the tissues. Serotyping is recommended for epidemiological surveillance and when vaccination with bacterins is being considered. Serotyping should be conducted in reference laboratories to prevent misidentifications.

The bacteriologic diagnosis of chronic PPP is more complex. It is usually difficult to isolate App from chronic lung lesions, such as those observed at slaughter. Detection of bacterial antigens or nucleic acids in tissues by using either immunohistochemistry or PCR, respectively, is not routinely performed. Detection of App from healthy carrier animals is even more difficult and should be attempted only in exceptional cases. Only highly experienced laboratories can reliably detect App in carrier animals using well-standardized techniques.

Serology is the most powerful tool for the diagnosis of sub-clinical infections. Many serological assays have been developed but only two major categories of tests are currently used: serotype/serogroup specific and App-species (all serotypes) specific. One of the serotype/serogroup specific tests is the complement fixation test (CFT). It is seldom still used however and is available only in very few labs in the USA. The CFT has low sensitivity and the specificity varies depending on the lab performing the test. The most popular test that is able to identify serotypes/serogroups is the LPS-based ELISA test. Commercial kits based on these antigens are used in several laboratories in the USA. These ELISA tests can identify serogroups/serotypes as follows: 1, 9 and 11; 2; 3, 6 and 8; 4 and 7; 5, 10; and 12. ELISA tests with mix antigens (detecting more than one serotype at the same time) are also available as kits in the USA. A multi-App assay using the same antigens and detecting all serotypes at the same time is also available in Canada.

A commercial ELISA test detecting antibodies to the ApxIV toxin is offered in different laboratories in USA. This test is specific for App, but it cannot differentiate among serotypes. The test may be useful for the routine surveillance of high health status herds known to be free of all serotypes. However its use in conventional herds is questionable. Conventional health herds may be infected with more than one App strain of low to mild virulence and as a result demonstrate a high prevalence of reactors using this test. Moreover recent results suggest that this test is less sensitive than LC-LPS ELISA when the prevalence of infected animals is low.

Therapy

Antibiotic therapy is effective in clinically affected animals only in the initial phase of the disease, when it can reduce mortality. The choice of the antimicrobial should be based on experience, clinical response and eventually laboratory sensitivity testing. Antimicrobials should be given by injection as affected animals often do not eat or drink normally. To ensure effective and sustained blood concentrations, repeated injections may be required, depending on the pharmacokinetic properties of the drug used. The success of therapy depends mainly on prompt treatment following the early detection of clinical signs. Water treatment may be used to treat affected groups of pigs which have normal water consumption. Medicated feed may be useful if food and water intake have not decreased significantly.

Feed and water medication can be used to prevent acute outbreaks. Continuous medication or pulse dosing may be practiced for a few months but other measures should be implemented to control the disease and reduce the use of antimicrobials and the antimicrobial sensitivity of the organism should be monitored by clinical response and, if necessary, by laboratory sensitivity testing as acquired resistance may develop. Strategic medication should be targeted at periods of high risk, which can be identified through clinical examinations, necropsies, and serological profiling. In spite of apparent clinical success, it must be remembered that antibiotic therapy alone will not eliminate infection.

Prevention

When stocking a breeding herd it is recommended to choose a genetic supplier that can guarantee that the breeding stock will be free of all or at least the most virulent App serotypes. This requires that the supplier has implemented a health scheme which includes regular serological monitoring, postmortem examinations of casualties as well as an effective biosecurity program. Open communication between the veterinarians of the supplier and the buyer is essential to ensure that all health requirements are addressed.

Once a herd has been infected, it is difficult to eliminate the organism. The first priority must be to control economic losses. Vaccination may provide good protection against morbidity, reduce mortality, reduce the number of treatments required, and improve growth performance. The quality of the carcass may also improve, resulting in fewer condemnations and reduced slaughtering costs. The decision to vaccinate should be carefully evaluated; the costs of mortality alone should not be the sole consideration, because the other effects on productivity listed above contribute to the benefits of vaccination. Vaccination of late nursery or early grower pigs is usually advised; animals should not receive the primary vaccination until after8 weeks of age to avoid interference with maternal antibodies. Sows can be vaccinated at any stage of pregnancy without adverse effects and replacement animals can be vaccinated before their introduction into an infected herd.

Several vaccines are available. Commercial vaccines fall into two main categories: the killed organisms (bacterins) and the subunit toxin-based vaccines. Autogeneous vaccines (which are bacterins) are not commonly used in North America. Most commercially available vaccines are also bacterins. Vaccination with bacterins is serotype specific. Subunit vaccines, composed mainly of the three major toxins (ApxI, ApxII and ApxIII) have been developed and give protection against most serotypes under experimental conditions as well as in field trials. Toxin-bacterin combination vaccines have recently been commercialized and field results will be available in the future.

Eradication

Infected herds may attempt eradication of the organism. Several procedures have been successful but a careful economic evaluation is recommended before starting an eradication program. Depopulation and restocking with pigs from certified App-free herds is one effective rmeans by which to eliminate the organism. This method is usually implemented in commercial herds which are facing severe PPP problems as well as other health issues (e.g., PRRS). Nucleus herds have to use other methods to preserve their blood lines. One approach that has succeeded in the past is medicated early weaning, as App was shown to be a relatively late colonizer in piglets. Certain serotypes of App have been reported as successfully eliminated using serological testing, antibiotic treatment and partial depopulation (e.g., 1, 5, 7). However, it should be emphasized that antibiotic treatment can not completely eliminate App from carrier animals. Thus antibiotic treatment is only a tool to reduce transmission of App during the eradication process.

Conclusion

Even if PPP is generally well controlled in the USA and Canada it remains a concern for some producers and their veterinarians. However knowledge of the disease has greatly improved in the last 20 years and efficient tools are now available to help manage the disease.