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Review

Current perspectives on the diagnosis and epidemiology of *Mycoplasma hyopneumoniae* infection

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Abstract

Mycoplasma hyopneumoniae is the principal aetiological agent of enzootic pneumonia (EP), a chronic respiratory disease that affects mainly finishing pigs. Although major efforts to control *M. hyopneumoniae* infection and its detrimental effects have been made, significant economic losses in pig production worldwide due to EP continue. *M. hyopneumoniae* is typically introduced into pig herds by the purchase of subclinically infected animals or, less frequently, through airborne transmission over short distances. Once in the herd, *M. hyopneumoniae* may be transmitted by direct contact from infected sows to their offspring or between pen mates.

The 'gold standard' technique used to diagnose *M. hyopneumoniae* infection, bacteriological culture, is laborious and is seldom used routinely. Enzyme-linked immunosorbent assay and polymerase chain reaction detection methods, in addition to post-mortem inspection in the form of abattoir surveillance or field necropsy, are the techniques most frequently used to investigate the potential involvement of *M. hyopneumoniae* in porcine respiratory disease. Such techniques have been used to monitor the incidence of *M. hyopneumoniae* infection in herds both clinically and subclinically affected by EP, in vaccinated and non-vaccinated herds and under different production and management conditions. Differences in the clinical course of EP at farm level and in the efficacy of *M. hyopneumoniae* vaccination suggest that the transmission and virulence characteristics of different field isolates of *M. hyopneumoniae* may vary. This paper reviews the current state of knowledge of the epidemiology of *M. hyopneumoniae* infection including its transmission, infection and seroconversion dynamics and also compares the various epidemiological tools used to monitor EP.

Keywords: *Mycoplasma hyopneumoniae*; Diagnosis; Epidemiology; Transmission; Pig

Introduction

Mycoplasma hyopneumoniae is the principal aetiological agent responsible for enzootic pneumonia (EP) in pigs. Other pathogens such as *Pasteurella multocida*, *Actinobacillus pleuroneumoniae*, *Mycoplasma hyorhinis*, *Streptococcus suis*, *Haemophilus parasuis*, *Bordetella bronchiseptica* and *Arcanobacterium pyogenes* are also frequently involved (Thacker, 2006). The disease is characterised by high morbidity and low mortality and although pigs of all ages are susceptible to *M. hyopneumoniae* infection, EP is usually not observed in animals younger than 6 weeks of age. The prevalence of EP is particularly high in animals of mid-finishing to slaughter age and the severity of clinical signs is dictated by the strain of *M. hyopneumoniae* involved, infection pressure, the presence of secondary infections and by environmental conditions. When *M. hyopneumoniae* infection is not complicated by concomitant pathogens, the disease can take a subclinical course with mild clinical signs consisting of chronic, non-productive

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cough, reduced rate of average daily weight gain (ADWG) and reduced feed conversion efficiency. When secondary pathogens are involved, clinical signs include laboured breathing and pyrexia, and deaths may occur (Maes et al., 1996).

M. hyopneumoniae is intimately involved in the pathogenesis of porcine respiratory disease complex (PRDC), a disease involving both bacterial (those potentially involved in EP listed above) and viral (porcine reproductive and respiratory syndrome virus [PRRSV], porcine circovirus type 2, Aujeszky's disease virus, swine influenza viruses [SIVs] and porcine respiratory coronavirus) pathogens. Porcine respiratory disease complex typically affects finishing pigs of between 14 and 20 weeks of age and is characterised clinically by depressed growth rate and feed conversion efficiency and by anorexia, fever, cough, and dyspnoea. This disease has been referred to as the '18 week wall' given its higher prevalence in pigs of this age (Dee, 1996).

Although improved management methods and the judicious use of medication and vaccination have greatly alleviated the detrimental effects of EP on herd health and on carcass quality, EP-associated economic losses remain important within pig production worldwide (Thacker, 2006). These losses are mainly due to decreased ADWG, increased feed conversion ratio, increased medication costs and, in some cases, to higher mortality rates (Maes et al., 1998). No recent estimates of the financial losses attributable to EP are available and these are likely to vary considerably between herds (Maes et al., 1998).

A sound knowledge of the routes of transmission of *M. hyopneumoniae* and of the other pathogens associated with EP is necessary to control the disease as well as to understand the factors that influence the pathogenesis. In the next sections we review current knowledge of *M. hyopneumoniae* transmission and seroconversion dynamics in different swine production systems and compare the different epidemiological tools used to monitor EP. The existence of *M. hyopneumoniae* strains with different virulence characteristics and the molecular techniques available to detect them are also discussed.

Epidemiological and diagnostic tools to assess *M. hyopneumoniae* infection

The investigation and control of infectious disease is critically dependent on the availability of appropriate diagnostic tools. Several diagnostic methodologies are used to monitor *M. hyopneumoniae* infection.

Clinical signs

The main clinical sign of EP is the gradual onset of a chronic, non-productive cough, particularly in pigs at the finishing stage of the production cycle. Co-infection with the additional pathogens detailed previously results in fever, anorexia and laboured breathing. The onset of coughing, although gradual, can be inconsistent and of variable intensity depending on the infecting dose of *M. hyopneumoniae*. To identify pigs with non-productive coughs, animals need to be observed over a considerable time-span and should be encouraged to move. Quantifying the number of coughing pigs in a given period of time (the 'coughing score') has been used in transmission (Meyns et al., 2006; Marois et al., 2007) and pathogenesis studies (Morris et al., 1995a; Vicca et al., 2003) and has also been used in the assessment of the efficacy of *M. hyopneumoniae* vaccines under both natural (Maes et al., 1999; Moreau et al., 2004) and experimental (Thacker et al., 2000) conditions. However, given the lack of diagnostic specificity of coughing and that subclinically affected pigs would not display it, additional diagnostic modalities are required.

Abattoir surveillance

The assessment of respiratory disease within a pig herd by lung 'lesion scoring' at abattoir inspection is frequently used to estimate the incidence of EP and its impact on carcass market price. It has been estimated that the lungs of at least 30 animals should be examined to provide a reliable measure of the prevalence and severity of the pneumonia at herd level (Davies et al., 1995). Such surveillance may also be useful in detecting subclinical disease which can adversely affect production during the fattening period. However EP lesions are not pathognomonic of *M. hyopneumoniae* infection as other organisms such as SIV can produce similar lesions (Thacker et al., 2001).

Retrospective evaluation of the prevalence of EP in a herd by abattoir surveillance is limited in that this approach only identifies chronic lung lesions at the end of the production period and does not provide information regarding the ongoing respiratory health of the pigs during fattening (Noyes et al., 1990). Similarly, the presence of additional bacterial pathogens such as *A. pleuropneumoniae* can cause severe pleuritis that mask EP lesions. Lesion resolution may lead to false-negative results or to an equivocal diagnosis of early mycoplasmosis (Sørensen et al., 1997). The scoring systems used most frequently in EP abattoir surveillance are summarised in Table 1. The subjectivity involved in the visual estimation of the proportion of lung consolidated and the lack of diagnostic specificity of these lesions, limit abattoir surveillance as a diagnostic approach and, therefore, the use of additional confirmatory methods is needed.

Bacteriological culture

The isolation of *M. hyopneumoniae* from affected lungs by bacteriological culture is considered the 'gold standard' diagnostic technique (Thacker, 2006) but isolation of the pathogen requires specialised Friis medium. Sørensen et al. (1997) compared the detection of *M. hyopneumoniae* by culture, immunofluorescence assay (IFA), enzyme-linked immunosorbent assay (ELISA) and by a polymerase