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Brief Communication

Association Between Production of Fibrinolysin and Virulence of *Staphylococcus hyicus* in Relation to Exudative Epidermitis in Pigs

Staphylococcus hyicus is the causative agent of exudative epidermitis (EE) in pigs, characterized by a generalized infection of the skin with greasy exudation and exfoliation (*L'Ecuyer* 1966). *S. hyicus* is a natural part of the skin flora of healthy pigs worldwide (*Wegener* 1992), and several different strains may simultaneously colonize the same pig (*Wegener* 1993a). Both virulent and avirulent strains can be present simultaneously on diseased piglets (*Wegener et al.* 1993), and virulent strains can be isolated from healthy carriers (*Devriese* 1977, *Park & Kang* 1988). The pathogenesis of EE has only been studied in a limited number of studies, but EE most likely occurs as a consequence of skin trauma that exposes the dermis and facilitates establishment of virulent strains. The exact mechanism of infection is not known, but a number of potential virulence factors including capsule production, protein A, coagulase and catalase production has been suggested as potential virulence factors in the initial pathogenesis of EE (*Wegener* 1990). *Amtsberg* (1979) showed that virulent strains of *S. hyicus* produced an exotoxin that resulted in the separation of cells in the epidermis which caused exfoliative lesions. The endotoxin has recently been found to be a protein of approximately 30 kDa (*Andresen et al.* 1993, 1997).

A large number of different virulence factors has been described in different staphylococcal species, especially *Staphylococcus aureus*. One of these is fibrinolysin or staphylokinase. Staphylokinase is a protein produced by many *S. aureus* and *S. hyicus* strains (*Devriese et al.* 1978, *Devriese & Kerckhove* 1980) that binds to plasminogen and converts it into plasmin that dissolves proteins and fibrinogen. The potential role of fibrinolysin in pathogenesis of bacterial infections is not known, but it has been speculated that it might help the bacteria in obtaining amino acids and in colonization by dissolving fibrinogen and other proteins. Production of fibrinolysin has previously been described in *S. hyicus* from pigs in different countries in Europe (*Devriese et al.* 1978). This study describes the occurrence of fibrinolysin production among virulent and avirulent isolates of *S. hyicus* as well as a collection of isolates of unknown virulence from healthy and diseased pigs in Denmark.

Nine virulent and 9 avirulent isolates of *S. hyicus* characterized for virulence by infection studies (*Wegener et al.* 1993) were examined for production of fibrinolysin. Furthermore, one hundred *S. hyicus* strains of unknown virulence from clinical lesions (n = 72) and healthy pigs (n = 28) from 100 different herds in Denmark were investigated. These strains belonged to a large number of different geno- and phenotypes (*Wegener* 1992). All strains were tested for production of fibrinolysin using dog serum as plasminogen source as described by *Devriese & Kerckhove* (1980). Furthermore, 16 iso-

lates producing a positive reaction in dog serum were investigated for activation of porcine plasminogen (*Devriese & Kerckhove* 1980).

All of the 9 virulent strains produced fibrinolysin, whereas only 4 of the 9 avirulent strains gave positive results. A total of 44% of *S. hyicus* strains originating from 100 different Danish pig herds produced fibrinolysin; 37 (51%) of the 72 strains from lesions, compared to 7 (25%) of the strains from healthy pigs. The association between production of fibrinolysin and origin from a lesion or a healthy pig was calculated by the chi-square test using epi-info. A significant association between the ability to produce fibrinolysin and origin ($p = 0.017$) was found. All of the 16 investigated fibrinolysin positive isolates did also activate porcine plasminogen. However, the reactions were weaker than with dog serum.

The association between fibrinolysin production and isolation from lesions and the presence of fibrinolysin production in all of 9 virulent strains compared to only 4 out of 9 avirulent strains of *S. hyicus* suggest that fibrinolysinproduction might play a part in the pathogenesis of EE, possibly as a prerequisite for establishment of the infection. This suggests that fibrinolysin production is one of several virulence determinants in *S. hyicus* counting among other factors capsule formation and toxin production (*Wegener* 1992).

Previous studies (*Devriese & Kerckhove* 1980) have shown that fibrinolysin from *S. aureus* does not activate porcine plasminogen. In this study fibrinolysin from *S. hyicus* strains was found to activate porcine plasminogen. This could indicate that fibrinolysin from *S. hyicus* differs from fibrinolysin from *S. aureus*. Previous studies on fibrinolysin in *Streptococcus* species, named streptokinase, have shown some degree of host specificity of fibrinolysin from different bacterial species (*Ellis & Armstrong* 1971, *Castellino* 1979, *Leigh* 1993). The potential involvement of fibrinolysin production in *S. hyicus* in the pathogenesis of EE needs further investigations.

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