Swine dysentery due to *B. hyodysenteriae* – a re-emerging problem worldwide

Control, treatment and eradication of *Brachyspira hyodysenteriae* from infected farms is complex and time-consuming. A combined approach of thorough treatment and management practices may assist in a successful eradication, as Frédéric Vangroenweghe DVM MSc PhD-Vet Sci PhD-Appl Biol Sci Dipl. ECPHM explores below

B. hyodysenteriae provoking swine dysentery is a widespread pathogen worldwide. It is responsible for a clinical disease characterised by an acute form with bloody diarrhoea including mucus and necrotic material or a more chronic form without the blood. Diagnosis is well-established in most countries, using a combined approach of clinical signs, necropsy and, eventually, bacterial culture and/or polymerase chain reaction (PCR). A combined approach of thorough treatment and management practices may assist in a successful eradication.

AETIOLOGY AND PATHOGENESIS

B. hyodysenteriae, the primary cause of swine dysentery, is an anaerobic gram-negative beta-hemolytic spirochete.[1] Besides *B. hyodysenteriae*, other species can also occur in swine such as *Brachyspira pilosicoli* and *Brachyspira hampsonii* – both pathogenic species – and *Brachyspira murdochii*, *Brachyspira intermedia* and *Brachyspira innocens*, which are less pathogenic to non-pathogenic species.[2] During the last decade, a clear increase in the prevalence of *B. hyodysenteriae* has been observed. This increase might be explained by the ban on antimicrobial growth promoting antimicrobials in Europe (since 2006), increased spread within the swine industry through carrier animals (which might be infected gilts, piglets or fatteners), unhygienic transport conditions, changes in basic feed composition, underestimated importance which is mainly due to the change in clinical picture (to more mild forms without blood and mucus) and continued issues with insufficient external biosecurity in many farms throughout the world.[2] The pathogenesis of *B. hyodysenteriae* starts with an oral uptake of contaminated material from the environment or through contact with clinically or sub-clinically infected animals. The ingested pathogens attach to specific attachment locations – the extracellular matrix proteins – on the surface of the colon mucosa, before they can proliferate and destroy the colonic mucosal surface.[1,3]

Following attachment, pathogens start to produce several toxins, of which hemolysin is one of the most important ones. The pathogen is attracted to the colonic mucus, which seems its favorite protein source, and proliferates in the mucus layer, resulting in muco-haemorrhagic colitis, characterised by thickened mucosa covered with blood and necrotic material. This results clinically in bloody faeces with necrotic material, quite typical for swine dysentery. The interval between initial infection and first clinical signs may vary from two days to two months, depending on initial infection load, presence of stress factors, age of the infected animals and composition of the intestinal flora.[2]

Swine dysentery typically occurs in the age category from weaning until the end of fattening, with an infection peak between eight and 12 weeks of age. Pigs suffering from the disease have little to no fever, but show persistent diarrhoea evolving from mucoid to bloody aspects with addition of necrotic material.[1] The faecal colour evolves from yellowish over red-brown with bloody content to a more concrete aspect.[1] Concurrently, affected pigs have a rapid loss of body condition combined with a rough hair coat, an empty belly and dirty hindquarters. These aspects heavily impact the economics of swine production with a long-term decrease in average daily weight gain and a deteriorated feed conversion rate.[4] Exceptionally, sows and suckling piglets are affected, resulting in carriers with intermittent excretion and occasional clinical signs.[2]

DIAGNOSTIC APPROACH: FROM MACROSCOPIC LESIONS TO LABORATORY CONFIRMATION

Diagnosis of swine dysentery due to *B. hyodysenteriae* can be made based on clinical signs and macroscopic lesions upon necropsy combined with laboratory analysis.[2] Pathological lesions associated with *B. hyodysenteriae* only occur at the level of the colon and are characterised by oedema of the colon wall, erosions and diffuse bleeding, abnormal content

(blood, mucus and necrotic material) and a distended colon (see Figure 1). An ideal sample for laboratory analysis is faecal material collected from animals with typical clinical signs. Faecal material can be subjected to microscopic examination with immunofluorescent staining. However, this microscopic method only detects spirochetes in a non-specific manner. The golden standard for confirmation of *B. hyodysenteriae* continues to be bacteriological culture followed by additional testing for antimicrobial sensitivity.[2] The entire timeline towards confirmation including antimicrobial sensitivity will typically take about six to nine days. Therefore, recently, PCR tests have been developed for more rapid confirmation within two to three days. These tests can, however, not be combined with antimicrobial sensitivity testing.[2,5]

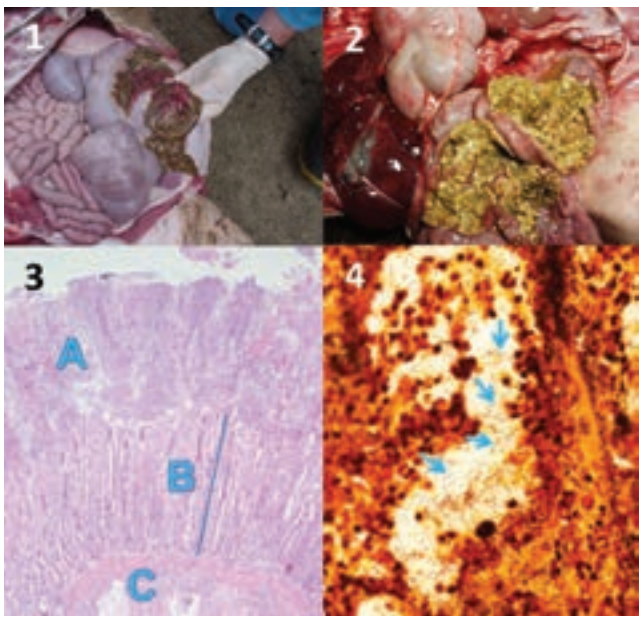

Figure 1: 1-2 – macroscopic lesions characterised by swollen haemorrhagic colon mucosa with necrotic material and bloody contents. Photo: Frédéric Vangroenweghe; 3 – microscopic lesions characterised by massive necrotic debris (A) on top of the damaged and disorganised colon mucosal epithelium (B); 4 – specific staining demonstrates the presence of spirochetic bacteria (arrows) in the lumen of the colonic crypts. Photo: Gerwen Lammers.

EPIDEMIOLOGY

B. hyodysenteriae occurs worldwide and has country-dependent occurrence within Europe with an estimated 5-20% of the pig farms affected. Some countries, such as Denmark, have eradicated the disease, whereas in other countries – Spain, Germany, Belgium and Eastern Europe – the disease prevalence has been increasing over the last decade.[6,7] Recent reports on re-emergence have been published in US and Canada, Spain, Brazil and Italy.[7-15] Swine dysentery can occur in two different clinical forms: acute or chronic. The acute form is typically characterised by the occurrence of mucus, blood and necrotic material, whereas the chronic form does not necessarily have blood. Morbidity (= number of affected animals) is typically about 75%, whereas mortality can vary from 5% up to 25% depending on each specific situation and strain virulence.[1,2]

Introduction and persistence of *B. hyodysenteriae* is mainly determined by the occurrence of healthy carriers, which can excrete the pathogen for at least 90 days following recovery from clinical disease – and spread through vectors – such as fomites (boots, materials), rodents (rats and especially mice), flies and companion animals (dogs, cats).[2] Mice can carry the pathogen for over six months in their intestines, while rats may be a reservoir for over two months. Most other vectors serve as 'mechanical vectors' which limits their 'carrier' period. Moreover, the pathogen can survive under favourable conditions associated with organic material for several weeks or months within the affected farm premises. Another main reservoir is, of course, the manure pit. Therefore, the level of manure should be regularly monitored in order to omit re-occurrence of infection originating from the manure pit.[2]

CONTROL AND TREATMENT OF *B. HYODYSENTERIAE*

Individual treatment of animals in *B. hyodysenteriae*-affected farms does not eliminate the pathogen from the farm or its environment. Treatment based on antimicrobials is intended to eliminate the pathogen from the colon, without any additional effect on the recovery of the colon mucosa. Moreover, individual treatment increases the risk of underdosing, which may induce antimicrobial resistance in the long-term. Several antimicrobials can be used in the treatment of swine dysentery such as lincomycin, tylosin, tylvalosin, lincomycin-spectinomycin, tiamulin and valnemulin.[2,5] However, for eradication purposes, only two antimicrobials from the pleuromutilin group remain eligible: tiamulin and valnemulin. Most of the antimicrobials are administered through water medication, since acutely diseased animals continue drinking, whereas feed consumption heavily decreases. Water medication should be performed with some key essential elements in mind: good water quality and cleanliness; water hardness; equal water distribution to all pigs; and long-term stability of the product in the water.

Antimicrobial resistance of *B. hyodysenteriae* to multiple key antimicrobials is an important element in the choice of product.[5] Therefore, upon confirmation of *B. hyodysenteriae* from diagnostic material, antimicrobial sensitivity testing should be performed to evaluate treatment success. Recently, single or multiple resistance to antimicrobial agents used for control and treatment of *B. hyodysenteriae* has been reported worldwide.[7-15]

Recently, a novel non-antibiotic Zn-chelate product was reported to be efficacious in treatment of swine dysentery due to *B. hyodysenteriae*.[16,17] Following a six-day treatment using water medication, pigs excreted significantly fewer bacteria and had a good recovery of general clinical condition and faecal clinical score (consistency, color and additions). Field experiences with the novel Zn-chelate show clinical improvement of *B. hyodysenteriae*-affected animals from three days of treatment onwards with improved faecal

consistency and pigs' general clinical condition.[16,17] Zn-chelate prevents the pathogen from attaching to the colon mucosa, thus resulting in no pathogen proliferation within the colon.[16] Moreover, existing lesions in the colon mucosa recover rapidly, improving the overall colonic function. This results in improved average daily weight gain in Zn-chelate treated animals during and after the treatment period. Besides application in treatment of *B. hyodysenteriae*, off-label use for control and treatment of *Brachyspira pilosicoli* has successfully been explored. Practical field experiences with the Zn-chelate product for the treatment of *Brachyspira pilosicoli* demonstrated clinical success at the registered dose during a 10-day treatment period, which is slightly longer as compared to the six-day treatment period for *B. hyodysenteriae*.[18]

ERADICATION STRATEGIES FOR *B. HYODYSENTERIAE*

Eradication of *B. hyodysenteriae* solely based on antimicrobial treatment may not be fully successful without additional management and hygienic measures. Complete eradication protocols for *B. hyodysenteriae* consist of several important key steps, such as effective treatment with susceptible antimicrobials, extended external and internal biosecurity measures, vermin control (rodents, flies and birds) and thorough cleaning and disinfection programmes to the pathogen from the environment and the animals themselves.[2,7] The different specific aspects of a typical *B. hyodysenteriae* eradication protocol are discussed in the next paragraphs.

1. Cleaning and disinfection

Cleaning and disinfection of both sows and environment are the cornerstones of eradication. Even if all other pillars would be perfectly carried out, survival of *B. hyodysenteriae* within the environment would imply a significant risk of re-infection following a succesful antimicrobial treatment protocol. For efficient cleaning and disinfection, several crucial steps have to be taken in order to get maximal result in terms of reduced environmental infection pressure, including all stable equipment at and above pig level. Moreover, sanitation of manure pits should be included in the protocol (see Figure 2).[2]

Figure 2: Different successive cleaning and disinfection steps to obtain maximal hygienic results.

2. Vermin control

As already mentioned within the epidemiology section, rodents, flies and birds can be short-term or long-term vectors or even carriers of the pathogen, implying a risk for re-infection. Therefore, bird entry should be completely blocked through specific measures at air inlets or upon use of natural ventilation. Elimination of resident rat and mice colonies is essential in preventing them to serve as vectors or carriers to the pathogen. Even fly control should be considered important, since maggots develop in the manure pit and may bring the pathogen back to the pigs during their evolution.[2]

3. Biosecurity measures

Biosecurity measures consist of both external and internal biosecurity. External biosecurity measures should omit new pathogens from entering the farm through limited visitor entrance, clear separation between dirty (external) and clean (internal) paths within the farm premises and good quarantine facilities for introduction of new animals. Internal biosecurity measures are predominantly intended to prevent pathogens present in one section of the farm (eg. fattening) to further spread through other sections. This can be obtained through clear separation of internal sections based on animal categories with changing facilities for coveralls, boots and hand hygiene in-between. No sharing of materials and no trespassing of personnel without the necessary precautions from one section to the other should be permitted, even during weekends when time pressure might be higher on the limited number of personnel present on the farm.[2]

4. Antimicrobial treatment protocol

When all preceding elements have been set in place and checked for functionality, the farm should be ready for the most important and final phase in eradication of *B. hyodysenteriae*: treatment with an antimicrobial with proven efficacy towards the farm-specific strain. Pleuromutilins (tiamulin/valnemulin) have been shown to be the preferred antimicrobials for eradication. The protocol consists of a prolonged antimicrobial treatment (20-28 days) combined with sanitation of sows and premises from 10 days' treatment onwards. Following 10 days of treatment, animals are considered free of *B. hyodysenteriae* and will, therefore, not be shedding anymore. This should be the correct time point to start decontamination of the environment. Following the decontamination phase, animals should be treated for another seven days before the treatment is discontinued.[2]
Depending on the farm structure and the presence of difference age categories, different eradication options are possible (see Table 1).

- **Total farm treatment**
  Most suitable option for wean-to-finish herds with an inadequate farm structure related to internal biosecurity. All animals present on-farm should be exposed to

Table 1: Eradication options for *Brachyspira hyodysenteriae*.

Eradication strategy	Farm type	Farm size	Internal biosecurity level	Cleaning & disinfection	Eradication costs
Depop/repop	Fattening	All	All	++	±
Total treatment	Wean-to-finish	< 250 sows	Low	++	++
Partial treatment	Wean-to-finish	All	High	++	+

antimicrobial treatment. This approach is quite expensive and only performed in smaller and older farms that are unsuitable to one of the next options.

- **Sow treatment with increased internal biosecurity**
  Most suitable option for farms with good possibilities to upgrade internal biosecurity in order to separate *B. hyodysenteriae*-negative treated animals from animals that still remain infected. This approach can save in treatment costs and only considers piglets born from an entirely treated sow as negative to the pathogen. A prerequisite to success in this protocol is the perfect separation of both animal categories for the time being, since negative piglets will be moved through the farm and might be re-infected in case of small biosecurity breaches.

- **Full depopulation/repopulation**
  Most suitable option for fattening units, where all-in/all-out can be performed per building or for the entire farm before restocking the farm with *B. hyodysenteriae*-negative animals. Before restocking, the crucial steps in cleaning and disinfection also have to be taken.

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