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Clinical consequences and management implications of large bowel diarrhea in growing pigs

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Introduction

It appears that the prevalence of large bowel diarrhea is growing pigs has increased over the last 5 years. This has been evidenced by an increase in the number of submissions to the diagnostic lab for agents associated with large bowel diarrhea (*Brachyspira hyodysenteriae, B pilisicoli, Salmonella*)[1] and with the increase in the emphasis on grow finish diarrhea at swine veterinary conferences. For many clinicians, large bowel diarrhea (LBD) in growing pigs is new clinical scenario as the control measures of AIAO and multisite production[2] along with improved diets had reduced the prevalence of LBD to below clinically significant levels. This "old but new" disease in the North American swine herd has caused many clinicians to ask probing questions about why the disease has reemerged and what practical, systematic control measures are available in modern production systems.

In the era of modern genomics and bio-technology much of what we understood about the causes of LBD in pigs has come into question. Simple, single agent models of disease do not accurately reflect the ecosystem diversity in the hind gut of pigs[3] and therefore the potential root causes of LBD. With our inability to model the complicated changes in the ecosystem in experimental models clinicians are left with a dearth of information about the economic outcomes of LBD and the economic benefits of interventions. Even within the confines of infectious disease little is known. Although the entire genome for *Brachyspira hyodysenteriae* (Bhyo) has been sequenced, no virulence factors have been confirmed and none of the other *Brachyspira spp.* have been sequenced.[4]

Clinical management of LBD is hindered by an inability to access economic outcomes, understand economic intervention points, and accurately delineate the root cause of the clinical presentation. Evidence based approached to management are desperately needed to improve the economic outcomes for swine producers as the clinical prevalence of LBD appears to be increasing.

Clinical experiences

My personal clinical experiences have changed dramatically over time with respect to large bowel diarrhea in finishing pigs. Historically in pigs fed indoors on totally slatted flooring LBD, except for the occasional case of atypical Lawsonia intracellularis infection that was presented as only a colitis and not ileitis, was a rare clinical diagnosis. A review of personal clinical observations from 1998 to 2005 suggested that clinical LBS was present less in less than 5% of the lots observed in AIAO production in total slatted flooring. A significant increase in the number of diagnostic submissions for pathogens associated with LBD over the last 4 years (Table 1) supports these clinical observations. There are numerous potential reasons that the number of diagnostic submissions has increased for LBD associated diseases including better and more rapid tests, sampling bias by veterinarians and a true increase

Table 1: Trends in clinical diagnostic tests for large bowel diarrhea in finishing pigs- 2004 to 2011. Cases submitted for diarrhea workup in pigs between 8 and 30 weeks of age to the Iowa State or University of Minnesota Veterinary Diagnostic Labs. Samples were either tissue or fecal samples from clinically affected pigs. Each case represented between 3 and 10 pigs. If one pig was positive in case then case was considered to be positive. There were no major changes in vaccination or medication strategies over time for enteric pathogens in the data that is represented.

Year	2004-2005	2006-2007	2008-2009	2010-June 2011
Brachyspira cultures*	0/4	0/1	2/3	7/10
Lawsonia PCR	3/6	5/16	4/25	4/27
Salmonella cultures*	0/1	8/8	8/24	11/15

* Pos cases/total cases in period

in disease prevalence. The data that is available prevents an accurate assessment of the true reason for the increase and likely it is a combination of all. However, it is plausible to infer from both the clinical records and diagnostic data that number of cases of LBD are increasing.

The root cause for the cases of LBD that I have been associated with has been varied. Often a definitive diagnosis of a single agent has been impossible to achieve. LBD due to Bhyo has been a rare diagnosis and even in that single case it did not fit the classical description of Swine Dysentery. More typically, the presentation has been a mild, mucoid colitis with no significant pathogens isolated. In about an equal number of cases we see a Salmonella species of various serogroups and multiple serotypes within each serogroup or a non-hemolytic *Brachyspira* species that is not Bhyo or *B pilisocoli* based on PCR differentiation. Investigations of water quality for mineral concentrations have been inconsistent in their results with high concentrations of Iron and Sulfur in some effected sites and not in others.

Dietary changes have also been investigated and cannot fully explain the trend in increased LBD is finisher pigs. Over the last 4-5 years there has been a steady increase in the amount of soluble fiber included in the diets of pigs that I work with. Most of the fiber has come from an increase in the feeding of corn co-products from the ethanol and high fructose corn syrup industries. When comparing the AIAO lot level prevalence between feed mills and diet formulations there is no clear trend of a specific formulation or ingredient source that accounts for the increase in LBD. The source of the pigs does not appear to be associated with occurrence of LBD either.

Clinical management of LBD in my experience has been frustrating. The inclusion of anti-infectives in the water has almost universally relieved symptoms temporally. Interestingly the anti-infective selected for therapy has not seemed to influence outcome. The use of multiple classes of anti-infectives thought to be effective on *Brachyspira* but not S*almonella* (pleuromutilin, lincosomides and macrolides) have produced similar clinical outcomes to those thought to not be effective on either *Brachyspira* or *Salmonella* (tetracyclines). The aminoglycosides which have demonstrated sensitivity to the salmonella isolates from clinical cases have generally been ineffective in controlling clinical LBD with our without a diagnosis of salmonella infection. A long term reduction in the within group incidence (number of cases of diarrhea per 1000 pig days) of LBD has not been successfully achieved with oral anti-infective therapy. In some cases it appeared that long term administration of tiamulin or lincomycin though the feed was effective in reducing incidence over the long haul. In other groups which were not medicated clinical signs resolved on their own about the same time that medication was included in other groups. This casts doubts on the real efficacy of long term anti-infective administration for the control of non-specific LBD.

The economic impacts of LBD in finish pigs have not been clear. Common metrics of biological performance (ADG, FCR, Percent sold of placed) have not been different in the groups affected with LBD and those that were not affected. Obliviously there are challenges with this type of analysis in that the true status of each of the groups (clinical vs. non-clinical) may be wrong, measures of performance on a commercial scale are often insensitive, there is no way to account for the impact of treatment, and many other things influence biological performance besides a single disease. With those restrictions on the interpretation of the analysis, it is clear that he impact of LBD over a 2 year period and a high number of groups appear to be no more than a minor impact on economic performance. This reinforces the divergence clinical impressions and economic outcomes in veterinary medicine.

Contributors to clinical presentation and management strategies

The cause of non-specific LBD in finishing pigs appears to be multifactorial. Swartz has compared the large bowel of the pig to the rumen of the bovine due to the large number and diversity of microorganisms present in both organs.[1] In both cases what appear to be minor changes in the micro environment can have dramatic impacts on microbial ecology and in the case of the rumen well described clinical impacts. In the case of the mono-gastric large bowel much less in known about what can cause these shifts in the micro environment. There have been numerous studies over the last 30 years looking at the impact of diet on hind gut ecology.[3,5,6] None have shown a consistent impact of one source or type of fiber on the ecology of the gut but methodologies have been different and compared to current techniques crude in their ability to measure the diversity of the ecology in the colon. Even with these challenges it is clear that there is a significant impact of diet on the ecology of the hind gut.

It is reasonable to infer from both the rumen and observation that changes in the ecology of the colon would lead to some inflammation of the gut wall. The production of mucous by the crypt cells is a primary response to inflammation in the hind gut. Mucous in some cases may actually promote the growth and attachment of *Brachyspria spp.* leading to a completive advantage for these organisms.[1] It is plausible to assume that in the absence of histologic lesions the presence of "non-pathogenic" *Brachyspira spp.* on culture may just reflect general inflammation of the colon and not a specific disease state. The same may be true for *Salmonella spp.*

The management of LBD needs to be a cooperative effort between the veterinarian, nutritionist and production team. The veterinarian must make every effort to implement an effective diagnostic plan to rule out Swine Dysentery (SD) due to Bhyo. Schwartz has summarized an effective approach that would be a good baseline for any investigation.[1] The management of SD is outside the scope of this paper but has been well described by numerous authors.

In the absence of a confirmed diagnosis of SD due to Bhyo a multi-disciplined approach needs to be utilized. While difficult to determine, the first step is to measure the economic impact of the LBD on the production system. This appears to be a syndrome where the clinical impression is more severe than the economic impact and could easily lead to interventions that are more expensive than the disease. In particular recommending changes to the diet needs to be done with caution as there is no clear link between specific changes in the diet and resolution of clinical signs. Most likely the LBD resolves as equilibrium in the ecology of the hind gut is achieved much like the rumen adapts to diet changes. While a change in diet might reduce the prevalence of groups with LBD or the incidence of LBD with in groups the cost of the change could easily be much higher than the cost of the disease.

The use of anti-infectives needs to be carefully monitored and a more robust assessment of outcomes completed. While clinical impressions of a short term resolution of clinical signs may appear to warrant the use of anti-infectives, long term reduction of with in group incidence and known economic benefits of intervention are needed to justify their use. As veterinarians we need to take the lead with this emerging condition to understand if anti-infectives are justified and if they are what the optimum strategy is for their deployment.

Clinically there is evidence that common disease management practices can be effective for minimizing the lot level prevalence of LBD in finishing pigs. First, good between group hygiene appears to be critical to controlling all forms of enteric disease. As an industry we often fail to implement adequate cleaning between batches of finishing pigs. It is a very rare for me to observe a finishing or wean to finish barn between batches that has all the organic matter removed. This lack of cleaning coupled with short downtimes between batches that do not allow for adequate drying lead to an increase in the number of enteric organisms in the barn when pigs are placed. Over time this shift in environmental contamination can lead to outbreaks of enteric disease.

Adapting intensive cleaning programs designed for the elimination of Toxigenic *E coli* from nurseries have been effective for a variety of enteric diseases including salmonellosis and ileitis due *to L intracellularis*. The key to these programs is rigorous third party inspections for the removal of organic matter and extended dry time (typically 14 days post passing inspection). While I have not deployed these practices especially for LBD, the within group incidence of all diarrhea following intensive between batch cleaning has been for all practical purposes zero. This low tech but high intensity program is one example of where insuring implementation of basic animal care strategies could be highly effective in reducing the impact of disease. Unfortunately, the basics are not as "flashy" and require a deeper commitment to process than new technology. As an industry there is much we could gain from insuring implementation of current processes and investing less in new processes and interventions.

In summary, control of LBD requires a proper diagnosis and a team based solution that addresses the multifactorial causes of LBD. A more complete understanding the economic outcomes of the disease and of potential interventions is needed if we are to make systematic progress on limiting the impact of LBD in finishing populations.

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