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Field experiences with PMWS control and management

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Effective control and management of postweaning multisystemic wasting syndrome (PMWS) remains elusive. As with porcine reproductive and respiratory syndrome virus (PRRSV) and other modern pig diseases, PMWS has reduced the margin for error in management of pigs with regard to biosecurity, environmental parameters, and timing of identification and treatment of sick pigs. The argument has been advanced by Segales et al. (2004) that PCV-2 may be immunosuppressive based on analysis of immune system lesions and characteristics of PMWS disease that include hallmarks of other immunosuppressive diseases (Roth, 1999):

- illness from organisms of normally low pathogenicity
- repeated illness due to same organism
- vaccination failure
- multiple, varied disease syndromes occurring simultaneously in a herd

While these observations frequently coincide with the presence of circovirus in the field, a mechanistic explanation of immunosuppression is still needed. Clinical research trials to date have primarily utilized gnotobiotic (GN), colostrum-deprived (CD), cesarean derived/colostrum-deprived (CDCD), early weaned pigs (SEW and MEW) and colostrum-fed (CF) pigs (Allan, 2004). As a result, these clinical trials utilize animals of greatly different health status than those encountered in production. Evaluation of field interventions in typical production settings has been extremely limited.

When pooling experiences among veterinarians faced with managing this syndrome, several trends become evident:

- Clinical presentation of PMWS as associated with porcine circovirus type 2 (PCV-2) specifically is difficult to distinguish from the clinical appearance of several multiple-etiology disease infections, mal-adjustment, and impacts of sub-optimal management.
- Vaccination and treatment tools to address PCV-2 specifically are limited at the present.
- Control and management rely on trouble-shooting and improving general disease control methods.

PMWS control and management

Field observations, clinical research, and combinations of both suggest the following opportunities for impacting the clinical course of disease. Every specific site or case has elements that are unique, and broad application of all of these may not be appropriate in every case.

Identify clinical signs of wasting early

Early identification of pigs with clinical signs of wasting is actually most important during the diagnostic phase of case management. Pigs that are early in the course of infection yield diagnostic information pertinent to what initiated the wasting rather than what organisms have thrived in the pigs' weakened state. In field experiences, it has been valuable to identify a subset of pigs to intensively monitor in chronically affected pig flows for the onset of wasting signs. It is especially valuable if these pigs can be individually weighed at frequent intervals, such as twice per week. As reduced weight gain relative to the group identifies a pig as falling back, diagnostics can be initiated to assess lesions associated with the onset of wasting rather than cataloging the lesions that result secondarily from a prolonged wasting event.

Characterize pigs with signs of wasting

Try to thoroughly characterize pigs with clinical signs of wasting. Confirm the presence of PCV-2 in tissues with characteristic lesions in pigs that are clinically wasting. Grossly, disease combinations have been observed that appear similar to PMWS, including combinations of porcine reproductive and respiratory syndrome virus (PRRSV) and *Salmonella typhimurium* or *Actinobacillus suis*. Pigs with a clinical appearance of PMWS may also be chronically affected by gastric ulceration or be maladjusted to the nursery or finisher environment. Interventions applied to address true PMWS cases that are associated with PCV-2 might be counter-productive if the true culprits are other etiologies. Some of the suggestions that follow include altering vaccination schedules to avoid PCV-2 infection, and these might be counter-productive if they yield poorer immunity for an alternative cause of the clinical appearance.

The most effective control programs address a commonality among pigs with clinical signs of PMWS, rather than

a broad spectrum approach to all potential risk factors for PMWS. However, the multifactorial nature of the disease, lack of understanding of all underlying risk factors, and complex field environments that have not been duplicated in controlled studies make identification of common factors among affected pigs quite difficult. In field management of PMWS, degree of success is usually positively correlated with how thoroughly the affected pigs have been characterized. Multiple diagnostic submissions are preferable as well as serologic characterization of the herd for common respiratory and enteric pathogens. In most cases, time spent planning and targeting a diagnostic assessment of the herd versus time spent revisiting broad, poorly guided approaches will actually shorten the time to improved performance.

Evaluate concurrent disease

You should evaluate concurrent disease and establish timing and relative contribution to morbidity and mortality. Focus especially on PRRSV and porcine parvovirus (PPV) that have been implicated in field observations and by the literature as having potential interactions with PCV-2. In one study, pigs coinfected with PCV-2 and PPV had significantly more severe lymphoid depletion than PCV-2-only infected pigs, but vaccination with a killed parvovirus vaccine did not prevent clinical PMWS or reduce the severity of lymphoid depletion in co-infected SEW pigs (Opriessnig, 2004).

Additionally, it is critically important to evaluate any disease or environmental factor that compromises the pig's positive nutritional energy balance given that a clinical appearance of wasting is an expression of negative energy balance regardless of cause. Subclinical ileitis may be a critical factor in individual animals while not a problem when evaluated at the herd level. Anecdotally, outbreaks of respiratory disease and the onset of clinical wasting signs have been correlated with poor ventilation, power outages, feed outages, and temperature extremes.

As summarized by Ellis et. al. (2004), studies have revealed synergy between PPV and PCV-2 to increase the severity of PMWS. Cases of porcine respiratory disease complex (PRDC) frequently include PRRSV, swine influenza (SIV), and *Mycoplasma hyopneumoniae* as co-infecting agents with PCV-2. While the mechanistic basis has yet to be confirmed, atypically severe hepatic lesions have been observed in pigs co-infected with PCV-2 and pseudorabies virus (PRV) (Ellis, 2004).

Vaccinate pigs

Vaccinate pigs for diseases that are present and can be effectively controlled. Diseases that can be reliably controlled with vaccination in PRRSV-positive field environments include SIV, *Mycoplasma hyopneumoniae*, *Lawsonia intracellularis*, and *Salmonella cholerasuis*, among others. In situations where maternal protection is effective through the age when wasting pigs appear, prefarrow vaccination of dams is preferred. This would be the case with swine influenza vaccination of dams when the offspring appear to begin wasting at 8-10 weeks of age.

Limit exposure and circulation of diseases

Identify potential sources of infection and, at a minimum, confirm that these sources are positive for the organism in question. Frequently, nearby pigs of unknown status are identified as potential sources of infection when their disease status is best described as unknown. There are two potential losses as a result: 1) time spent addressing the wrong source, and 2) failure to identify the correct source of infection that, in most field cases, is less obvious but more responsive to intervention.

All of the specific biosecurity measures necessary to prevent movement and spread of most swine diseases have not been completely revealed. However, in cases where minimal biosecurity standards are not implemented to prevent exposure to disease, it may be impractical and even ethically indefensible to initiate more radical therapies such as serum exposure or planned infections with virulent agents. These minimum biosecurity measures are a change of boots and coveralls and a washing of hands when entering any new airspace that contains a different source, phase (as in farrowing, nursery, finisher, etc.), or known health status.

Biosecurity measures have typically focused on preventing disease entry into the farm from outside sources. However, opportunity to improve pig health still exists in controlling disease circulation within farms and production groups. Regarding diseases that have poor or inconsistent response to vaccination and biosecurity interventions, such as PRRSV, interrupting circulation within the farm may alter the duration of clinical losses. Focus should be placed on procedures or pig flows that bring animals of different ages or stages of gestation into direct contact. Examples of procedures that, when eliminated, improved the clinical picture include:

Creating a continuous flow scenario: A scenario has been observed where production was scaled back on a batch farrow-to-finish farm leading to additional room in the farrowing barn. Sows were normally gestated full term outside, but given the additional room, a decision was made to take advantage of the empty crates to allow sows to acclimate prior to farrowing. This essentially created a continuous flow farrowing room. Litters produced from this scenario contained PRRSV-viremic piglets for greater than a year despite no additional pig entries to the farm and a lack of clinical signs in sows. When the process was discontinued, viremic piglets were no longer found in farrowing, nursery performance improved, and ELISA titers on sows began to decline. As PRRSV circulation

declined, the percentage of pigs with clinical signs similar to those in PMWS declined, and severity was reduced in individual pigs.

Holding back "light" finishers: The process of holding back light market animals on a site effectively converts any all-in, all-out nursery or finisher facility to continuous flow and uses the animals with the worst health to accomplish the change. In every case, the financial cost-benefit of retaining these pigs must be weighed, and it must include not only the additional value at marketing but additional variable costs and a reasonable estimate of negative performance impact on subsequent groups. This should be discontinued or moved off site. Additionally, this process can be self-perpetuating as increased health challenge leads to more lights which leads to potentially greater exposure of subsequent groups.

Prolonging weaning of fall-behinds: Similarly, holding back small pigs at weaning and moving these into younger rooms for additional gain to meet a weaning criterion is ill-advised. This, again, creates a continuous flow scenario that perpetuates disease circulation and challenges vaccination and treatment protocols.

It seems unlikely that anyone versed in pig health or production would argue that all-in, all-out is not preferable from a health perspective. Many can and do argue that it is not preferable from a facility utilization and profitability perspective. In these situations, the cost-benefit of all-in, all-out must be calculated with specific inclusion of the cost of increased mortality and weight variability in the production group. These evaluations often create a falsely low perception of the value of all-in, all-out because "lights" or "late finishers" are sent to facilities with low or no overhead to gain additional weight prior to marketing. These continuous flow, high disease sites must be accounted for in the cost-benefit equation and recognized as a potential source for continued infection of subsequent production groups.

Reduce age and weight variation in production groups

The goal is to limit the variation in the group so that room-wide environmental conditions and timing of vaccine application is valid for all individual pigs in the group rather than the average age/size/weight of the group. There are several mechanisms to achieve this:

Separate gilt offspring: Try to separate gilt offspring or evaluate gilt immunity versus sow immunity in the source herd. This will improve timing of vaccination in downstream flows and improve vaccination success.

Avoid commingling highly variable sources: Finding pigs that are evenly matched in age and health status for assembly into commingled groups is difficult. As a result this process likely contributes to the development of a subset of wasting pigs by increasing variability of the immune status/age/weight of the group beyond the immune status/age/weight targeted by the intervention whether it is a desired room temperature or vaccine timed to miss maternal antibodies. All pigs in a group have their environmental, nutritional and vaccination needs met by a single setting or procedure applied to the group. Animals for which an alternate timing or setting is necessary will not respond as well are likely at higher risk for concurrent diseases or maladjustment. While a direct impact on PCV-2 or PMWS has not been well established, it is advisable to limit or eliminate commingling to facilitate management of the group at a level appropriate for all pigs in the group.

Increase weaning age: Field experiences certainly and repeatedly indicate that increased weaning age reduces the number of pigs that waste due to maladjustment. Changes in weaning age must be evaluated in the context of current production goals, reproductive performance, and cost.

Severely restrict cross-fostering: The perceived benefits of cross-fostering in the field are rarely, if ever, consistent with the benefit that has been measured experimentally. Cross-fostering has been shown to actually increase variation in weights and age in weaned groups. Invariably, improvement in consistency of weight in a wean group comes at the expense of consistency of age. Given consistent half-lives of maternal antibody decay, variation in age may be manifested as variation in immune status in the nursery, thereby promoting disease circulation.

Interestingly, the range of target cell types for infection with PCV-2 has been shown to change during *in utero* development (Sanchez, 2003). Examination of infected fetuses revealed virus in myocardiocytes, hepatocytes, and macrophages while only macrophages were found to be infected at one day of age. This leads to speculation that age might impact infection beyond variation in immune status.

Evaluate adjuvants and not merely antigens

Typically field vaccine decisions evaluate antigen and cost per dose with little assessment of adjuvant properties. In situations of confirmed PMWS associated with PCV-2, where vaccination cannot be avoided, changing to a vaccine with a less stimulatory adjuvant may be warranted. Thus far, oil and water adjuvants appear to be the most likely to exacerbate PCV-2 infection. The work of Hoogland et al. (2004) suggests that, at the early stages of infection (21 DPI), all adjuvants tested (oil-in-water, aqueous, aluminum hydroxide) increased the severity of lymphoid depletion associated with PCV-2. In the later stages of infection (35 DPI), the oil-in-water adjuvants (groups 1 and 3) increased the length of PCV-2 viremia,

increased the amount of PCV-2 in serum and tissue, and increased the severity of lymphoid depletion compared to the aqueous and aluminum hydroxide products.

Where wasting signs are not associated with PCV-2 infection, stronger adjuvants aimed at improving protection are preferred. Where oral vaccination is a viable alternative, it should be chosen over injection. This development highlights the need for careful and thorough diagnostic evaluation of wasting pigs, especially those with early clinical signs.

Eliminate dated vaccine regimes

Reevaluate any vaccine practice greater than one year old. Ideally, confirming exposure to the pathogen of concern without leaving the entire herd or flow susceptible to disease is the goal. To accomplish this, several potential approaches exist with the degree of risk correlated with the number of animals left naive: skipped whole groups, split barn trials, and sentinel animals. In flows where weekly groups are produced, an entire group can be skipped in the vaccine regime and monitored for signs of disease. This is potentially more sensitive than sentinel animals but also puts the entire group at risk of disease. Split barn group trials protect half the animals while leaving the remaining half susceptible to disease. The concern with this approach is that partially vaccinating a group changes the disease circulation pattern and degree of clinical response if exposed to disease. Therefore, this method may not be accurate for determining the potential severity of disease but should still confirm exposure. Sentinel animals are least sensitive and the lowest-risk approach to detecting exposure. In all three cases, unvaccinated animals are both observed for clinical signs and evaluated with the appropriate diagnostic tests for the presence of the pathogen of concern.

Disinfect with adequate regimens and products

Work by Royer (2000) revealed differences in disinfectant efficacy against circovirus and demonstrated that One Stroke Environ (ConvaTec Labs) and Roccal D plus (Winthrop Labs) were very effective at inactivating PCV's infectious potential; Clorox and ethanol were moderately effective, and Fulsan (Fuller Brush Co.) was minimally effective. All others tested (Weladol by Pitman-Moore, Inc.; DC&R by Hess & Clark, Inc.; Nolvasan solution by Fort Dodge Labs; sodium hydroxide; and UV light) were ineffective at inactivating PCV. These choices would likely be effective against other organisms that are implicated in clinical cases of wasting. Effective cleaning is crucial to disinfectant efficacy. Anecdotally, many consider the addition of a detergent to the regime to improve cleaning. This has not been substantiated in research trials measuring microbial counts.

Consider "serum therapy" as last resort

European veterinarians have experienced success anecdotally by exposing pigs at risk for PMWS to serum harvested from pigs that have recovered. This suggests that it might be a useful intervention in domestic cases of wasting. However, the differences in the clinical course of the disease between the US and Europe are significant, and this extrapolation must be used with caution. Additionally, there is inherent risk in the procedure since it is not possible to routinely eliminate other viral and bacterial agents from the injection, and the process generally requires harvesting serum from older pigs and injecting into younger groups. Points that are considered critical by most veterinarians with experience with this procedure include the following:

- Harvest serum from recovered pigs. This may require marking diseased pigs with tags and following the course of disease.
- Keep blood refrigerated; allow clotting overnight; use within 24 hours of harvest.
- Inject all pigs, IP, prior to clinical signs, if possible.
- Include a prophylactic antibiotic injection at same time.
- Screen donor pigs for PRRSV viremia prior to harvest of serum.

Summary

Control and management of postweaning multi-systemic wasting syndrome remains elusive. Further study of interventions in field settings is required concomitant with the development of vaccination and treatment technologies.

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