Managing reproductive failure in pig farming

Reproductive failure is one of the most important problems in swine production. Its consequences in terms of cost and production output can be devastating and may create very serious logistical and organisational problems. This is because reproductive failure changes the structure of the mating batches and increases the workload of the staff monitoring reproduction.

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Despite its profound repercussions, reproductive failure represents one of the most difficult problems to diagnose. This is because many factors can be involved, and these all play a role in the occurrence, severity, and evolution of the process. The most important of these are the time of year when the problem appears, type of facilities used and their management, environmental conditions in the buildings housing the breeding sows, the farm's state of hygiene, handling of the sows, semen, and mating, staff training and commitment, and overall health of the whole set-up.

How should reproductive failure in sows be addressed?

We should start by looking objectively at the problem and quantifying it. This can be achieved by performing a detailed and systematic analysis of the production data, especially any information related to reproduction, which should be broken down into blocks by parameter, production group, and time period. Thus, first, we would need to start by narrowing down the type of alteration observed (i.e., a high incidence of anestrus, percentage of returns to oestrus, abortion rate, number of non-pregnant sows at the time of farrowing, altered litter compositions, or a combination of all of these).

Because many factors are involved, a comprehensive and systematic approach must be applied to reach the correct diagnosis.

Next, depending on the parameters affected, we will have to delve deeper into their analysis. Thus, for instance, if an increase in the return to heat rate is observed, it will be imperative to determine whether these are returns to oestrus occur at the next expected heat cycle, after skipping a cycle, or are irregular, as well as whether they are early or late, because the causes of each of these problems differ. In addition, we must determine whether the changes are concentrated within a particular time period or if they affect a specific group of breeding sows.

Second, once the affected parameters are analysed, we should visit the farm to obtain detailed information from its staff and conduct a thorough examination of the animals, facilities, and management, leading to a combined study of all these data.

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All of this information will allow us to establish a presumptive diagnosis, starting by determining whether the origin of the problem is infectious or non-infectious. The probability of whether the cause will fall into one category or another will strongly depend on the parameters affected.

Differential diagnosis of anestrus and infertility

If we observe a problem related to anestrus or infertility, it is unlikely the cause will be infectious, especially in the absence of other reproductive changes or clinical signs in the sows. Thus, we should start by analysing and ruling out the roles different management factors may be playing.

1. Check the heat-detection protocol and staff training

When dealing with a problem related to anestrus, we should start by evaluating the protocol used on the farm to detect heat and the training of the personnel who implement it because poor heat cycle detection manifests as a false anestrus problem. We should also check the absence of heat cycles during maternity because these can lead to the false diagnosis of anestrus in sows who went through a heat cycle during lactation.

2. Conduct an ultrasound study

In parallel, we should carry out an ultrasound study to verify the absence of ovarian activity and other pathologies such as ovarian cysts that could interrupt the cycles of these sows. The latter can appear as a consequence of applying improper hormonal treatments, among other reasons. These studies can also be performed at the slaughterhouse by analysing the ovaries of any sows culled because of anestrus.

3. Rule out high-stress situations

Once the presence of problems related to false anestrus and ovarian issues has been ruled out, we should verify the absence of highly stressful situations that could lead to inhibition of the hypothalamic–pituitary–ovarian axis.

4. Carry out an analysis by time period

In parallel, an analysis by time period should be performed given that one of the most important factors in the appearance of anestrus is seasonality. Heat stress acts through two complementary mechanisms. On the one hand, it decreases the sows' ingestion capacity during lactation, leading to a negative energy balance that alters the secretion of certain hormones such as growth factors. On the other hand, it increases stress, leading to higher cortisol secretion. Both mechanisms result in a reduction in gonadotrophin-releasing hormone (GnRH), luteinising hormone (LH), and follicle-stimulating hormone (FSH) secretion, consequently causing reduced follicular development.

The same thing occurs when the photoperiod decreases, because it has an additive effect with heat at the end of summer, which usually coincides with most seasonal anestrus.

In addition, the deficit in GnRH, LH, and FSH production produces oocytes with a reduced quality, which translates into poor embryo quality and decreased functionality of the corpora lutea and a consequent reduction in the quantity of circulating progesterone. All of this causes significant embryo losses that lead to decreased fertility, which manifests as an increase in the number of returns to heat—both regular and irregular—and also usually accompanies problems related to anestrus.

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5. Analyse causes not related to seasonality

Returns to oestrus can be caused by factors other than seasonality, although the origin tends to be non-infectious. To reach a diagnosis, first we must determine the kind of returns to heat being observed.

When regular returns to oestrus predominate, regardless of whether they are returns to the next expected heat cycle or if a cycle is skipped, the most frequent cause is usually related to issues with heat detection and semen and mating management. The same rule applies if we observe early returns to heat, which inextricably corresponds to the mating of sows not in heat.

In contrast, the most common predisposing factor in irregular returns to heat is the presence of stressful situations after the mating. These may have different causes related to issues with the physical or social environment, feed, or other factors.

6. Rule out the presence of mycotoxins in the feed

The presence of mycotoxins in the feed is another factor which can be associated with low fertility and so this factor should also be ruled out.

7. Rule out infectious causes

Only when all the aforementioned factors have been evaluated will we be able to rule out possible infectious causes. These are usually sporadic and secondary to pathogens (generally opportunistic ones) that can produce endometritis and, less frequently, salpingitis. Nonetheless, pathogens that can cause death during the early embryonic stages and thereby causing the sows to return to heat should also be considered.

The latter are usually viruses that can reproduce in embryos. Among these, parvovirus and different members of the Picornaviridae family are particularly common. In addition, we must remember that mating sows who previously had a reproductive failure (usually abortions) due to an infection may end in further returns to oestrus if the endometrium is not given sufficient time to fully recover (because early embryo degeneration will occur after the mating). This kind of reproductive failure is indirect, meaning that we cannot blame the corresponding aetiological agents as the cause of these returns to heat. The same occurs when breeding sows have a systemic infection secondary to a pathogen that does not multiply in the reproductive system. In this case, fever causes the death of the embryos, which are very sensitive to spiking temperatures, especially at the beginning of gestation. In both cases, the pregnancy ends, and the sow returns to heat. This occurs, for example, in infections caused by porcine reproductive and respiratory syndrome virus (PRRSv). This disease does not directly cause returns to oestrus because it does not affect pre-implantation embryos, but it can indirectly cause sows to return to heat when they are mated following abortions or when they have a fever caused by PRRSv.

Differential diagnosis of abortions

Abortions represent one of the most difficult reproductive problems to diagnose in pigs. As before, in this case the first thing we must do is try to determine if the nature of the abortions is infectious or non-infectious. However, although it might be counter-intuitive, the available data indicate that the causative origin of most abortions on pig farms is non-infectious.

If the sow does not show any clinical signs, especially fever, the abortion was likely due to a non-infectious cause. On the contrary, if she has had a fever, the abortion was probably an indirect consequence of infection by a pathogen that does not replicate in the reproductive apparatus such as the influenza virus or *Actinobacillus pleuropneumoniae*, among others.

1. Determine whether the nature of the problem is infectious or non-infectious

Among abortions of an infectious nature, we must distinguish between those caused by pathogens specific to reproduction or not. The former exert their effect thanks to their ability to cross the placental barrier and damage the developing foetuses. These include pathogens such as PRRSv, the virus that causes Aujeszky' s disease and classic swine fever, among others, as well as bacteria such as *Leptospira interrogans* and *Brucellasuis*. The latter cause systemic illness in sows, inducing fever and the release of pro-inflammatory cytokines and prostaglandins which then cause rupture of the corpora lutea and subsequent expulsion of the developing foetuses.

To establish a tentative diagnosis, we should study factors such as morbidity, presentation of the symptoms (i.e., endemic or epidemic), distribution of abortions by farrowings, days of gestation, appearance of the aborted foetuses, presence of other reproductive alterations, and any other clinical signs, both in breeding sows and in other age groups.

As a general rule, we can say that non-infectious abortions (perhaps with the exception of those occurring in autumn) usually present endemically and are distributed over time, while those of an infectious nature tend to be concentrated in more defined periods. In the same way, abortions of a non-infectious nature tend to be distributed over the whole gestation period, while those with an infectious origin usually occur starting at days 70–80 of gestation.

However, what helps the most to determine whether abortions are of an infectious or non-infectious nature is the presence of other reproductive issues or clinical signs in sows or other other pigs on the farm, as well as the appearance of the aborted foetuses. Concomitant reproductive issues and the presence of other clinical signs, both in breeding sows and in other age groups, usually indicates the presence of a pathogen. In addition, the presence of lesions or autolysis on the foetuses indicates a transplacental infection by a pathogen specific to the reproductive tract.

In contrast, expulsion of fresh foetuses without lesions implies that the abortion was a consequence of corpus luteus ruptures, meaning that they did not suffer any pathological changes.

2. Differentiate between pathogens that are specific to reproduction or not

When collecting samples to confirm the diagnosis in the laboratory, we must ensure we differentiate between abortions caused by reproduction-specific pathogens and those caused by pathogens that do not multiply in the reproductive system.

In the former case, we should keep in mind that there is a time lag between the sow getting infected and the reproductive failure. Although this time period can vary, it is usually two to four weeks. This means that in many cases the pathogen will have already been cleared from the sow's circulation (for pathogens that cause viremia or bacteraemia) when the abortion occurs. Thus, the absence of these pathogens in serum samples from these animals is insufficient to rule out the possibility we may be seeing the effects of a disease process. However, the time elapsed from the time of infection often allows us to detect seroconversion. In addition, pathogens that specifically affect reproduction cross the placental barrier and so they will be detectable in the aborted foetuses. Nevertheless, we must remember that it is difficult to penetrate the placental barrier in sows and that normally only part of the foetuses will be infected. Therefore, to confirm the diagnosis we must test several foetuses from the litter (usually 4–6) and study several different litters. These foetuses should be sent whole to avoid environmental contamination problems that may skew the diagnosis. Placental samples are only useful in the case of certain bacterial infections such as that caused by *Brucella suis,* because most pathogens do not replicate in the placenta.

In contrast, the reproductive failure is acute when pathogens do not replicate in the reproductive tract and so the pathogen will not be present in the foetuses or the placenta. Therefore, it is best to take samples from the mother given that the pathogen should be detectable at the time of the abortion, although the best sample type will depend on the specific clinical suspicion. Samples should not be taken from aborted foetuses or placentas in these cases because the pathogen will not be found in these samples. Similarly, a seroconversion study is not usually appropriate in these cases because reproductive failure often occurs before the sow develops a specific immune response to the pathogen.

Lastly, when the clinical suspicion leans more towards non-infectious causes, the diagnosis is more difficult and can only be confirmed indirectly by ruling out other possible causes, correcting predisposing factors, and ensuring any potential problems are resolved.

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Apart from autumn abortion syndrome, the most common non-infectious causes are usually related to situations involving severe stress or notable nutritional imbalances.

Differential diagnosis of an increase in the mummified foetus rate

As in the previous cases, an increase in the number of mummified foetuses can have an infectious or non-infectious origin. The former are always related to viral infections that produce a moderate inflammatory process and allow the gestation to continue even after the death of the foetuses. This does not occur with bacterial infections. In contrast, non-infectious causes are related to placental insufficiency.

To make a diagnosis, we must analyse factors such as the distribution of mummified foetuses across farrowings, litter size, the size of the mummified foetuses, and presence of other reproductive changes or clinical signs in other pig age groups.

Litter size

The probability of placental insufficiency increases with the size of the litter and so in these cases, the number of mummified foetuses will tend to increase in tandem with the size of the litter.

On the contrary, this correlation will not be observed if the cause is infectious.

Size of the mummified foetuses

The size of the mummified foetuses also provides important information given that it indicates the age of the foetuses when they died. As a general rule, we can say that most pathogens produce mummified foetuses of different sizes as a consequence of their fairly slow and sequential intraplacental diffusion after crossing the placental barrier. This is the case for porcine parvovirus and the porcine enteric picornaviruses, among others. However, large, mummified foetuses can also be found accompanied by other reproductive alterations— usually abortions. This occurs in cases of PRRSv which very efficiently causes transplacental infections near the end of gestation.

In contrast, when piglet mortality is caused by placental insufficiency, the mummified foetuses are usually an intermediate size because they had died around days 70–80 of gestation when their size and demand for nutrients notably increases. In these cases, no other reproductive issues or symptoms will be seen in the breeding sows.

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Diagnosing an increase in the rate of mummified foetuses is not easy because this data is not usually well recorded, and in the case of infectious processes, there is the added difficulty that the pathogen responsible usually becomes inactive and degrades as a consequence of autolytic processes. For this reason, we must always collect targeted samples from litters with more than 2–3 mummified foetuses, as well as samples from different farrowing batches. These samples should include not only the mummified foetuses, but also any stillborn or weak piglets from the same litter.

The differential diagnosis should include many different pathogens, among which porcine parvovirus type 1, porcine enteric picornavirus, and other enteroviruses such as the encephalomyocarditis virus, porcine circovirus type 2, and PRRSv stand out. In addition, porcine circovirus type 3 has recently been added to this list because it is often associated with reproductive failure. It is possible that other recently described viruses such as other porcine parvoviruses or porcine circovirus type 4, may be added to the list as their effects of reproduction become more firmly established.

Conclusion

Reproductive failure in pigs can have different aetiologies which can include both infectious and non-infectious causes. Consequently, we must take a holistic approach to reaching a diagnosis by considering predisposing factors, the presentation of the process, and presence of other issues both in breeding sows and in growing animals.

Even so, reaching a definitive diagnosis is often complicated and many cases remain undiagnosed. When infectious causes are suspected, laboratory results can be very helpful, but success will greatly depend on selecting adequate sample types because it is common for no pathogen to be identified. We must also remember that many other reproductive alterations have a non-infectious origin and so laboratory work cannot be the only basis for a diagnosis.