How magnetic resonance imaging can determine vaccine reactivity

Disease prevention is becoming more and more important in swine production. Vaccination, together with biosecurity and general pig management, is the most important measure for disease prevention in pig production. Pigs are vaccinated against an increasing number of pathogens to safeguard their productivity. Most vaccines (especially killed vaccines) contain an adjuvant which modulates and enhances the immune reaction towards the antigen of the vaccine.

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They usually induce a non-specific immune response which facilitates the development of the specific immune response towards the antigen in the vaccine. It is well known that the choice of the adjuvant has an impact on side effects after vaccination.

Safety studies are required for the registration of vaccines. So, in general, registered veterinary vaccines are safe to be used in the target animal species. In swine medicine the productivity of the animals is of critical importance for the producer. Therefore comparing vaccine reactivity and the impact of the vaccines on pig productivity is of interest when it comes to choosing the right vaccine.

The use of MRI

Magnetic resonance imaging (MRI) allows scientists to characterise, to visualise and to quantify tissue reactions over time in living animals. It is therefore an ideal method to measure and to quantify tissue reactions after vaccination over time.

A research group at the Ludwig Maximilians University in Munich, Germany has established the use of MRI to measure vaccine reactivity in pigs. In a recent study they have compared two vaccine combinations against PCV and Mhyo which

Magnetic resonance imaging of a piglet.

are based on different adjuvants for their local tissue reactivity. In parallel they did another study with the same vaccines to see whether these vaccines have a negative impact on growth after vaccination.

For the first study eight pigs per treatment group were vaccinated either with FLEXcombo (Ingelvac CircoFLEX and Ingelvac MycoFLEX freshly mixed prior to administration – group A), which is based on an aqueous adjuvant; or with Porcilis PCV Mhyo (group B), which is based on a mineral oil.

Both vaccines were used according to manufacturer's instructions with the same injection volume (2ml). Pigs were vaccinated at the age of 25 days on the left side of the neck. On day 1, 8, 15, 22, 29, 36 and 43 after vaccination the quality and quantity of the local reactions at the site of injection were measured with an MRI system.

The volume of reactive tissue was measured per pig by comparing the signal intensity of the right and left side of the neck in three dimensions. The pattern of tissue reactions was different between the two treatment groups. In general, pigs in group B showed much more prominent tissue reactions compared to pigs of group A. The most prominent tissue reactions were seen in treatment group B at three and four weeks after vaccination.

Impact on growth

A second study was carried out in parallel to the MRI study to determine whether the two vaccine combinations tested in the MRI study have a negative impact on growth after vaccination.

The study was carried out at a commercial farm. A total of 201 crossbred piglets (Piétrain x German Landrace) were used. At 21 days of age the pigs were weighed and randomly allocated to one of three treatment groups (A, B and C). Treatment group A and B were vaccinated with the same vaccines used for the MRI study according to manufacturer's instructions.

Treatment group C was kept as a negative control group and injected with sodium solution (2ml) as a placebo. At 32 days of age all pigs were weaned, weighed and transferred to a nursery unit. At the end of the nursery period (74 days old) all pigs were weighed for a third time.

The average daily gain (ADG) was calculated for each group and compared statistically for three different periods: Period one from vaccination at three weeks of age to weaning at 4.5 weeks of age; period two from weaning to the end of nursery at 10.5 weeks of age and period

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Table 1. Results of the GLM analysis, representing the average daily gain of each group and time period including standard deviation.

	Vaccination-weaning	Weaning-finishing flat deck	Vaccination-finishing flat deck
A	174.02±6.97	493.46±22.10[a]	431.77±18.44[a]
B	168.89±6.84	458.38±21.93[b]	402.26±18.30[b]
C	180.44±7.03	495.98±22.09[a]	434.90±18.43[a]

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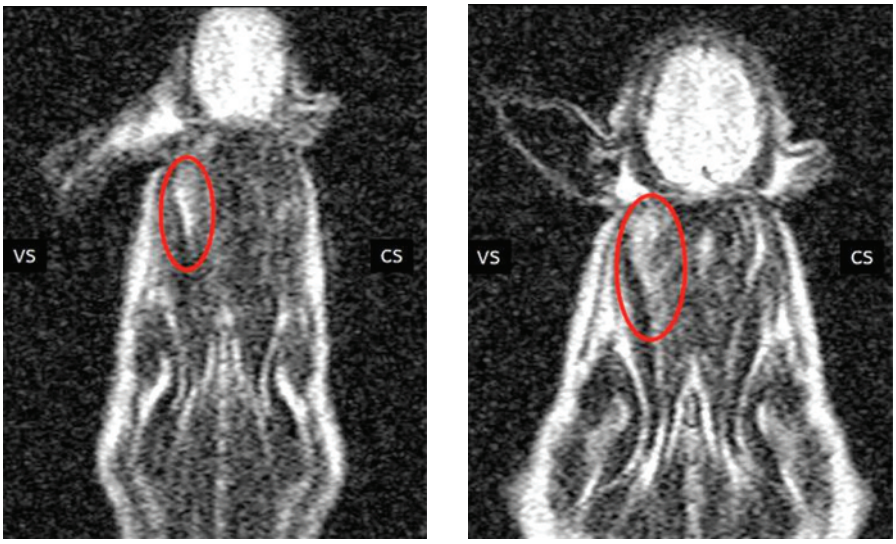
three from vaccination to the end of nursery. What did this second study reveal? During period one there was no significant difference between the three treatment groups.

For period two and period three, pigs of treatment group A and C performed equally well, whereas the pigs of treatment group B had a lower weight gain compared to the other two treatment groups. It is important to understand that during the trial period the pigs were not challenged either with PCV2 or with Mhyo.

Therefore, as all other factors were equal, the differences in weight gain observed in this study can most likely be attributed to differences in the reactivity of the vaccines.

Previous studies as well as observations from pig producers and veterinarians have shown that pigs vaccinated with a mineral oil based adjuvant will transiently change their behaviour and lay down more often. This change in behaviour is called 'buzzing'.

The results of the farm performance study are in a way surprising. The assumption was that the negative effect of a reactive vaccine would be seen immediately after vaccination because pigs that lie down more often take up less feed compared to pigs with a normal behaviour. But actually the study revealed that the difference in growth rate occurred later during the nursery period.



MR images of group A and B at day 22 after vaccination, showing a signal increase at VS in both groups with different distribution.

This is actually in line with the results of the MRI study which shows what happens at the site of vaccination. The strongest tissue reaction of the mineral oil based vaccine was observed three and four weeks after vaccination! This tissue reaction might cause discomfort in the pigs which also changes their behaviour. This effect is more subtle compared to the 'buzzing' seen immediately after vaccination.

Conclusions

When it comes to vaccine choices the reactivity of the vaccine should be taken into account.

The negative effect of a vaccine on pig performance might not only occur immediately after vaccination but can happen within several weeks after vaccination. ■