Intradermal & needle-free

The dermis as a prime site of delivery

by: Professor Artur Summerfield, Chair of Veterinary Immunology, University of Bern, Switzerland.

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The skin is most exposed to the environment and thus represents a major physical and immunological protection against injury and infection. Therefore, similar to the mucosal immune system, the skin has a coordinated system in which epithelial cells, resident immune cells, lymph and blood vessels operate very efficiently if the epidermal barrier is disrupted. This is the basis for using the skin as a site of vaccine delivery.

The skin comprises three main layers. The avascular epidermis, which is composed of several layers of cornifying squamous keratinocytes, is 30-140µm thick in pigs and represents the main barrier of the skin. The dorsal epidermis in the neck region is generally thicker than the ventral site, with a particular thin inguinal area. In addition to keratinocytes, the epidermis contains a type of antigen-presenting cell similar to dendritic cells (DC), called Langerhans cells.

The dermis in pigs is 10-13 times thicker than the epidermis and is composed of collagen and elastin fibres with many lymph and blood vessels as well as resident dermal DC, mast cells and fibrocytes. The subcutis as the third layer represents a fatty layer, which is approximately 12mm thick in pigs (Fig. 1).

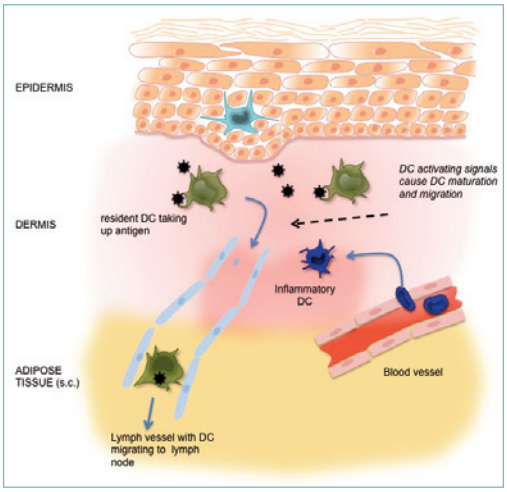

Fig. 1. The dermis represents an excellent site for vaccine delivery being rich in resident dendritic cells (DC), lymph vessels and blood capillaries.

Dendritic cells represent a specialised cell type of the immune system which play a major role in inducing and orchestrating immune responses. Therefore, it is essential to target this cell type for efficacious vaccines. DC are equipped with many receptors that are able to sense invading pathogens, such as Toll-like receptors which recognise pathogen-associated molecular patterns like viral nucleic acids or bacterial cell wall components. Triggering DC activation by such alarm signals is essential for induction of adaptive immune responses, including vaccines. Therefore, vaccines can be supplemented with immunostimulatory components triggering this process. After taking up invading pathogens or vaccine antigens, activated DC migrate through lymphatic vessels to the draining lymph nodes where immune responses are induced.

Within the skin, the dermal layer is best equipped to mount immune responses as it contains many resident DC, as well as many lymphatic and blood vessels. After intradermal vaccine deposition, resident DC will react and fulfill their functions as sentinels and antigen-presenting cells as described above. In contrast to dermal DC, Langerhans cells present in the epidermis are less efficient at stimulating immune responses. Inflammatory signals induced by immunostimulatory vaccine components will also trigger the extravasation of monocytes from the blood capillaries present in the dermis. Monocytes will then differentiate into inflammatory DC and macrophages, thereby creating a large pool of innate immune cells participating in the induction of immune responses. Importantly, the dermis is rich in lymphatic vessels through which antigen-loaded DC and free antigen will be transported to the lymph nodes where adaptive immune responses are induced. Dermal DC are particularly efficient at activating T lymphocytes, which are activated only by processing antigenic peptides presented in major histocompatibility complex molecules expressed at high levels on DC. In contrast, B lymphocytes are activated by unprocessed free antigen.

T and B lymphocytes will reciprocally activate each other, a process required for the induction of immunological memory. These anatomical and immunological conditions represent the basis for targeting the dermis as a site of vaccine delivery.

A review of published literature on the experimental comparison of intradermal (id) to intramuscular/subcutaneous (im/sc) vaccine injection in various animals and human demonstrate that while all parenteral vaccination routes are highly immunogenic with good vaccines, much lower antigen doses are necessary for id vaccination. It can be expected that improved adjuvants, specifically developed for id vaccines, will further favour this route of vaccine delivery. In addition, a most important advantage of id delivery is the possibility to employ needle-free safe vaccination devices such as pressure injection. Furthermore, id in contrast to im injection does not damage pig carcases and, is considered to be less painful and more animal friendly.

In conclusion, id vaccine delivery has a clear advantage for im/sc injections. In both human and veterinary medicine, several devices have been developed for this purpose, the main ones being pressure-based liquid jet injection, microneedles, and particle based injection principles. Although significant work is also invested in human medicine in less invasive transcutaneous immunisation techniques, such approaches will be less immunogenic due to the barrier function of the epidermal stratum corneum and less efficient delivery to immunogenic dermal DC.

In pigs, pressure devices, such as IDAL (MSD Animal Health) have proven to be very effective and safe for delivery of 0.2mL of a formally registered id vaccine. Based on the immunological benefits of id vaccination, this delivery route should become a consideration for the modern pig producer.

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Towards a new standard in pig vaccination

by: Rika Jolie, Global Technical Director – Swine

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In the pig industry, vaccines are traditionally administered intramuscularly using a needle and syringe. However, the disadvantages of this method have stimulated research into novel vaccine delivery methods. The good news: needle-free intradermal vaccination devices and dedicated vaccines are now commercially available, combining the benefits of needle-free injection and intradermal vaccine delivery.

Needle-free: the advantages

Needle-free vaccination reduces the risk of the spread of viral diseases such as PRRS, which may occur when using the same needle on multiple animals. Furthermore, it eliminates the risk of broken needles, abscesses and associated carcase trim and improves operator safety by avoidance of accidental needle-stick injuries. It also does away with the need for changing and disposal of used needles and reduces the volume of a vaccine dose – leading to less packaging waste and lower volume requirements for the cold chain. Needle-free vaccination also tends to be more precise and reliable by depositing a vaccine dose at the approximate same depth, delivering a proper dose every time.

Improved welfare

Another big advantage is the improved welfare of pigs, with needle-free vaccinations causing less pain and stress. A recent study shows that needle-free intradermal vaccination reduces the fear and pain reaction of gestating sows. "This is of particular interest in group-housed sows, where one sow's scream following a needle stick will immediately trigger excitement and apprehension in the entire barn or group," explains Ruud Segers, global R&D manager for swine biologicals at MSD Animal Health. "Needle-free vaccination will not only contribute to animal welfare but also makes for a calmer, more relaxed working environment for the vaccinators." Another study in a commercial pig farm evaluated the welfare aspects in suckling pigs after IDAL vaccination. Results found that piglets in the needle-free group were more active and had more suckling activity after vaccination than IM-vaccinated pigs.

Intradermal vs. intramuscular

And there is another major advantage: while traditional, syringe-needle vaccinations deliver a bolus of vaccine deep in the muscle, a needle-free injector such as the IDAL device disperses the vaccine more broadly in the skin. Overall, the immune response following intradermal vaccination can be faster and at least as good as traditional intramuscular vaccination – all with a much lower vaccine volume than used in traditional vaccination (0.2ml instead of 2ml).

IDAL: a collaborative success

The best-known example of a needle-free vaccination device in the pig industry is probably IDAL, developed in the Netherlands by Frencken Mechatronics in collaboration with Intervet, and which first officially appeared on the market in 2001. The technical development has since been taken over by Henke-Sass Wolf and MSD Animal Health, and improved models IDAL I and II arrived on the market in 2013 and 2014, respectively. The strength of the IDAL device is that

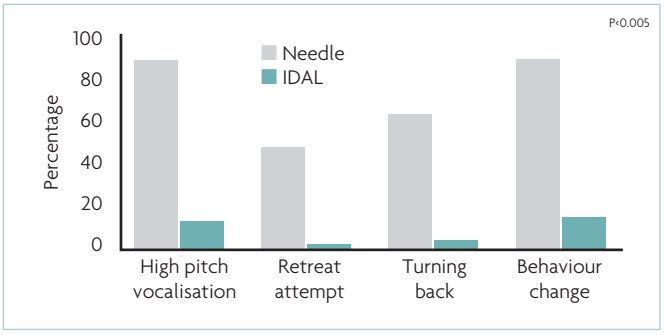

Fig. 1. IDAL injection reduces fear and pain reactions in sows compared to needle injections (42 sows in each treatment group).

it was developed in close collaboration with the vaccine manufacturer, alongside a growing vaccine portfolio specifically developed for use with IDAL. The IDAL was initially developed for the administration of live vaccines. Later, the technology was taken one step further to also administer inactivated vaccines, which need to be specifically developed. Dr Segers concedes that it is "a considerable challenge requiring a high level of expertise to get all of the necessary antigen and adjuvant in such a small volume in a stable emulsion." The first inactivated vaccine against Mycoplasma hyopneumoniae, introduced in 2013, outperformed an intramuscular vaccine in a field situation. In 2016, a similar vaccine against porcine circovirus infection was introduced and both the Mycoplasma and PCV Porcilis vaccines can be used at the same time in piglets around weaning.

A promising future

"Although IDAL was first introduced in the 1990s in the Netherlands, in particular to help with mass vaccination against Aujeszky's disease, it really took off in the past decade," comments Victor Geurts DVM, from MSD Animal Health. There are now over 400 IDALs in the field, meaning that nearly one in five Dutch farrow-to-finish and multiplier farms is using the device. A recent Dutch survey indicated a client satisfaction of 94.9%, with hygiene, animal welfare and reduced side effects most commonly cited as benefits.

Isidoro Pérez Guzman, technical manager of Agropecuaria Obanos, a Spanish pig production company with over 13,000 sows, sums it up best. "The IDAL system allows us to have easy, safe and effective vaccine administration while decreasing the stress in piglets and sows."

The needle-free future seems bright.

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Reducing antibiotic consumption in finishers

**by: K. Fiebig, J. Mischok, MSD Animal Health, Unterschleißheim, Germany,
G. Ernst, Vetpractice Ernst, Densdorf, Süderbarup, Germany.**

www.msd-animal-health.com

Needle free injection devices have been around in human medicine since the 1930s and were first introduced into veterinary medicine in the 1990s. In recent years, intradermal vaccination with a needle free device like IDAL (MSD-AH, Boxmeer, NL) has become available in the swine industry following registration of specifically developed intradermal vaccines for key swine diseases such as Porcine Circovirus (PCV), Porcine Reproductive and Respiratory Syndrome (PRRS) and Pseudorabies. Following is a case report of the impact of an intradermal PCV2 vaccine (Porcilis PCV) on various production parameters and antibiotic consumption on a German swine farm.

Porcine circovirus plays an important role in porcine respiratory disease complex (PRDC) by increasing lung lesions, reducing daily weight gains and more antibiotic use.

Following introduction of PCV piglet vaccinations and combined with improved management, clinical signs associated with PCV2 are less frequently observed. Although, farm managers (especially in closed-herd-systems) may decide to no longer vaccinate their piglets for PCV2, the following case report does support that even in a high health farm intradermal PCV2 vaccination has a return on investment.

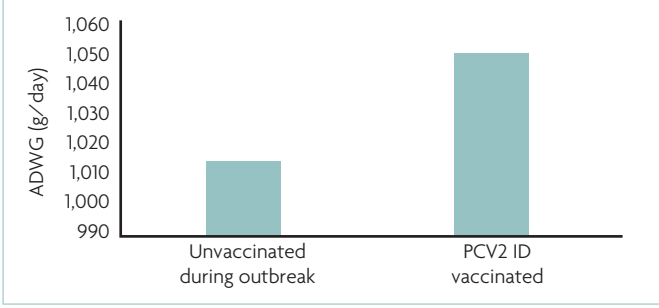
Background and farm history

The following study describes the effect of an intradermal PCV2-vaccine on production parameters after an acute PCV2 infection under normal field conditions in Germany. The study farm was a closed herd in Northern Germany (Schleswig Holstein) with nearly 2,000 sows and a three-week production system with about 140 sows per group. The herd is set up as a multi-site-production system and was classified as high health with excellent performance and low antibiotic consumption.

The herd has been PRRS-unsuspicious for years. The farrowing unit, piglet-nursery and fattening unit are located in three different locations to interrupt the infection chains. Sows were routinely vaccinated against Erysipelas, Parvo and Influenza, while piglets were non-vaccinated.

Despite high biosecurity measures, an acute PCV2 infection occurred in October 2016. The origin of the PCV2 infection was most likely through the purchasing of breeding animals, which is part of normal herd restocking. Although pigs were highly viraemic, they did not have any typical clinical PCV2-signs like PWMS or PDNS. After confirmation of the acute PCV2 infection, piglets were immediately vaccinated at 21 days of age with an intradermal PCV2 vaccine (Porcilis PCV ID) administered with a needle free device (IDAL).

Fig. 1. ADG (g/day) in PCV non-vaccinated and PCV ID vaccinated finishing pigs



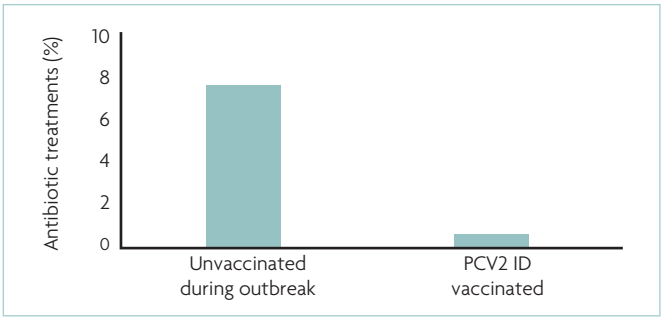


Fig. 2. Antibiotic treatments compared between PCV non-vaccinated and PCV ID vaccinated finishing pigs.

Results

The intradermal PCV vaccination stopped the acute PCV2-infection immediately. PCV2-viraemia reduced significantly in vaccinated piglets (from $10^{7.43}$ PCV2 DNA/µl serum to 10^{1}/µl serum). Vaccinated animals also had an improved average daily weight gain (from 1,014g/day non-vaccinated and affected piglets to 1,050g/day vaccinated animals – Fig. 1). Mortality rate in fattening decreased from 3.7% during the acute PCV2 outbreak to 1.3% in PCV ID vaccinated groups. The number of antibiotic treatments was also significantly reduced from 7.8% during the acute PCV2 infection to 0.6% after implementation of the PCV ID vaccination (Fig. 2). Since the introduction of the PCV2 vaccination, the proportion of medium to high grade pleurisies at slaughter dropped from 3% to 0.5%.

Discussion and conclusion

The current case report confirms that PCV2 infections can occur even in high health herds with high biosecurity standards. In addition, the results support that intradermal PCV2 vaccination of piglets further improved the already excellent performance parameters and carcase quality as well as reduced PCV2 viraemia and antibiotic use. Unrelated to the improved performance, the farm manager was satisfied with the needle free and intradermal application of the PCV2 vaccine because it made the vaccination procedure easier, faster and more animal friendly.

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Intradermal & needle-free

Going from strength to strength

by: Rika Jolie, Global Technical Director Swine, MSD Animal Health.

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A third generation intradermal needle-free injection device (IDAL 3G) for pigs has been launched worldwide by MSD Animal Health. According to those who tried it in the field, it's even better than its predecessor. But why go needle-free in the first place? "Needle-free and intradermal vaccinations are a perfect match," confirms Rika Jolie, Global Technical Director Swine at MSD Animal Health. "The needle-free approach has great benefits for both pigs and people: it eliminates the risk of disease transfer, broken needles in pigs and meat as well as needle-stick injuries in operators, and above all, it improves animal welfare." Pigs are less stressed during vaccination campaigns, and are less fearful of farm operators after needle-free vaccine administration compared to those using needles.

Satisfying consumer demand

During vaccination campaigns, "the same needles are often used for multiple animals, which blunts the needles, meaning the injection becomes increasingly painful for the next animal," confirms Olivia Azlor, Global Marketing Director for Swine at MSD Animal Health. But there is another reason why it is a perfect match: IDAL allows the vaccine to be delivered intradermal rather than deeper in the subcutaneous muscle.

"Compared to muscle tissue, the skin is much better adapted to vaccination as it is a truly immunological organ and contains many resident immune cells," confirms Ruud Segers, Head of Global Swine R&D at MSD Animal Health. "In the muscle, there are not only less immune cells, but they are not resident to pick up and deal with pathogens and antigens." The fixed volume of intradermal vaccination (0.2ml) is perfect for the purpose."It is enough to spread horizontally in the skin and to induce an immune response. A larger volume would just make the vaccine go elsewhere."

A growing vaccine portfolio

MSD is not new to the IDAL game. "We started developing needle-free vaccination some 25 years ago, in the Netherlands in the early 1990s. Our prime objective at the time was the eradication of Aujeszky's disease (pseudorabies), and prevention of disease transmission was crucial," explains Dr Segers. This is also why the first dedicated intradermal (ID) vaccine was a live vaccine against Aujeszky's disease – soon followed by one against the porcine respiratory and reproductive syndrome (PRRS). But inactivated vaccines have also been developed for IDAL, including against Mycoplasma hyopneumoniae and against the porcine circovirus.

"We had to overcome a number of additional challenges," admits Dr Segers. Because of the small volume, these vaccines not only require a tenfold higher antigen concentration, but they can only contain a tenth of the volume of adjuvant." Having two M. hyo vaccines – one for ID and one for IM administration – allowed the company to compare their performance in the field.

"The ID vaccine was found to significantly outperform the IM vaccine in terms of lung lesions and mortality." As a result, the company decided to focus on the intradermal vaccine alone – and not only because of its superior performance. "Intradermal vaccination is animal-friendly but it is easier on the operator, too. It's a pleasure to vaccinate sows in a calm, stress-free environment, without screaming pigs or chasing after them."

Improving the IDAL

IDAL is currently being manufactured by Henke Sass Wolf (HSW) in Germany. The first needle-free devices were developed in the 1990s and the first IDAL officially appeared on the market in 2001. HSW took over technical development in 2012, and improved models arrived on the market in 2013 and 2014.

Fast and reliable servicing

IDAL use requires well-equipped and well-trained local service centres. "A fast and reliable local service centre for IDAL devices is essential," stresses Jonas Riess. HSW provides calibrated technical equipment and a dedicated HSW team to train the local service team, followed by regular audits. Today, some 6,000 IDAL devices are in use world-wide, with service centres in Europe, Asia and Latin America. For regulatory reasons, the IDAL is not yet present in North America, "but may be introduced in the future," confirms Rika Jolie.

IDAL 3G: so what's new?

So what's different about IDAL 3G? "Firstly, its look has changed quite a bit," announces Rika Jolie, adding that the new design was prompted by customer feedback. Number one is ergonomics. The 3G is a lot more balanced, lighter and no longer top-heavy. "The handle is ergonomically shaped and the trigger is easy to hold down." The two-component surface provides for an easier, safer grip.

The menu on the display screen has become more intuitive, with two control buttons. The bottle cage is open, allowing for easier fitting and removal of vials. A belt clip can be fitted on either side of the device to suit both left and right-handed operators. IDAL 3G furthermore has a lithium-ion battery allowing for at least 1,200 injections. The service interval has also improved. "Once trained, farmers can carry out the 'small service' – nozzle replacement – themselves every 20,000 injections. And a full service by HSW will only be needed every 100,000 injections – instead of the current 12,000."

Well received in the field

And what is the feedback from the field so far? Stephan von Berg, Regional Global Technical Director Swine Europe at MSD Animal Health, reports. "We tested the 3G prototype on a number of commercial pig farms in Europe that were familiar with IDAL 2G. We asked the farmers to vaccinate 'as usual', without any specific instructions on handling or care. Even though these were only prototypes, so not as nice as the final product, all those who tested it preferred to keep the prototype!"

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Improving health and profitability

by: Christopher Chase, Department of Veterinary and Biomedical Sciences, South Dakota State University, Brookings SD. USA.

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Vaccination technology aimed at improving efficacy, minimising work place injuries, while achieving high worker compliance continues to be the holy grail for swine preventative medicine programs. The incorporation of needle free technology in herd closures along with other simple biosecurity practices has resulted in herds with improved health and decreased PRRSV infections without the use of costly air filtration systems. Needle free devices (NFD) limit animal-to-animal spread compared to needle administration. Vaccination of a PRRSV positive animal with a needle free device spread PRRSV to negative animals 25% of the time compared to 100% in animals with needle administration.

The importance of workplace safety cannot be overemphasised as a recent University of Minnesota study found that 86% of veterinarians surveyed indicated that needle stick injuries (NSI) were the number one physical injury. A review of six articles from 1996-2009 found that 70% of veterinarians had at least one NSI in the previous 12 months. Since the vast majority of pathogens infect the pig via the oral, gastrointestinal, respiratory or reproductive mucosal surface, efforts at improving efficacy have been directed at mucosal immunity. NFD delivery methods can enhance the mucosal immune response. With needle free devices (NFD), there is an enhanced intradermal (ID) dispersion of the vaccine in the tissue that affects the animal's immune response to an antigen. This wider dispersion of vaccine is thought to increase exposure of the antigen to antigen-presenting cells, thereby resulting in an improved immune response.

Transdermal vaccine delivery resulted in an enhanced immune response, when compared to traditional needle-and-syringe vaccine delivery. This includes enhanced antibody and enhanced cellular immune responses, which is antigen dependent. There have been over 50 vaccine studies with transdermal devices in swine. Results indicate an equivalent or better immune response with transdermal vaccination when compared with intramuscular vaccination with syringe-needle devices. No studies indicated a poorer response when NFDs were used. Although mucosal immunisation for enteric organisms can be achieved by oral vaccine administration in drinking water (Salmonella choleraesuis, S. typhimurium and Lawsonia intracellularis), their efficacy is affected by antibiotics and disinfectants. Other mucosal delivery methods, such as vaginal and intranasal delivery, have been used for systemic, respiratory and reproductive diseases in swine. Both of these methods require additional restraint and, depending on the stage of production, increase the stress on the animals.

The vaginal delivery device was developed to deliver a gonadotropin releasing hormone (GNRH) analog for oestrus induction. Since artificial insemination is a widely used practice in swine systems, this vaginal method is convenient. In a PRRSV positive herd, there was no measurable immune effect using a commercial PRRSV vaccine between 'vaginal PRRSV vaccination' and unvaccinated control animals. Autogenous vaccines have been delivered intranasally for swine influenza, H. parasuis and S. suis and PRRSV with mixed results. Only an intranasal attenuated swine influenza vaccine, recently registered in the US, has reduced clinical disease. There have been no direct comparisons between NFD and intranasal vaccination in terms of labour, efficacy or compliance.

Targeting problem diseases – swine flu and PRRSV

We reviewed four papers that administered commercial influenza vaccines with a NFD and they all demonstrated that efficacy was as good or better with a NFD compared to the needle and syringe method. With the emergence of new influenza strains, experimental DNA vaccine approaches have been developed to provide better protection. These DNA vaccination approaches can be done effectively with needle free technology. In one study, needle free delivery elicited improved antibody responses with the same efficiency as conventional injection in cross-protection studies. Additional work has been done with a polyvalent influenza vaccine administered with a NFD that protects against influenza.

There have been several developments with NFD and porcine respiratory and reproductive virus (PRRSV) vaccines. Prior to 2008, there were three studies that demonstrated that NFD vaccination was as effective as needle syringe injections. There are two modified live PRRSV vaccines licensed in Europe for intradermal administration with a specific needle free device. Two papers comparing intramuscular (IM) needle administration to intradermal (ID) administration of PRRSV vaccines resulted in a similar immune response to IM administered vaccines. More importantly, protection was found against a heterologous PRRSV challenge at a similar rate between the two routes with 1/10 the volume of vaccine being administered by the ID route. Additionally, there was a reduction in coughing and listlessness in the pigs vaccinated ID compared to IM pigs following PRRSV challenge. Non-peer reviewed work with ID PRRSV vaccines also indicated heterologous protection and extended duration of immunity following challenge at 24 weeks of age compared to IM administered PRRSV vaccines. New experimental PRRSV DNA vaccines administered with NFD devices have also been effective at PRRSV protection. NFD ID vaccination against PRRSV offers a similar improved efficacy with 1/10 vaccine volume as compared to IM MLV PRRSV vaccine. Therefore, ID vaccination is an effective reproducible method to provide PRRSV protection.

In summary, NFD technology coupled with improved biosecurity has resulted in healthier swine flows without the installation of expensive bio-filtration. Improved worker health and safety occurs by decreasing needle-syringe usage, which is the number one cause of swine worker injuries. Finally, mucosal immunity and excellent efficacy can be achieved with NFD while using a reduced volume of vaccine.

Intradermal & needle-free

Welfare benefits of intradermal vaccination

by Déborah Temple, Eva Mainau and Xavier Manteca, School of Veterinary Medicine, Universitat Autònoma de Barcelona, Bellaterra, Spain and Marta Jiménez, MSD AH, Spain.

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Vaccination is generally necessary to improve the health of animals through prevention of diseases. However, vaccination can cause discomfort because of the systemic reaction and pain due to the local inflammation at the injection site.

The following studies evaluate the effect of the needle-free IDAL vaccination method on the welfare of gestating sows and weaned piglets through behavioural, physiological and health parameters.

- Pregnant sows: A total of 90 pregnant sows (Landrace x Duroc) were included in the study. Sows were allocated 28 days after service to six identical pens in a commercial farm. Sows were vaccinated either by needle-free IDAL method (IDAL) or conventional intramuscular needle-syringe (IM) method with Porcilis PRRS (MLV European strain, MSD Animal Health). The volume of vaccine administered was 0.2ml in the IDAL group and 2ml in the IM group.

- Weaned piglets: A total of 339, 28 day old piglets were distributed in three groups: i) vaccinated with Porcilis PCV ID intradermally with IDAL (IDAL; 0.2mL); ii) vaccinated with Porcilis PCV intramuscularly (IM; 2mL); iii) control, not vaccinated (Control).

Pain reaction to the vaccination

The frequency of high pitch vocalisations, retreat attempts and turning back were significantly higher in sows vaccinated with the IM method. All these behaviours have been suggested as indicators of pain and anxiety in pigs. In contrast, the needle-free IDAL vaccination method prevents sows from developing acute fear and pain at the time of injection compared to conventional IM vaccination. In piglets, the frequency of retreat attempts was higher in the piglets vaccinated intramuscularly, however there was no difference between the three groups in terms of frequency of high pitch vocalisations. The fear/pain reaction was not as strong as in sows. The handling procedure induces a high level of arousal in the piglets that may have biased the evaluation of the vocal fear/pain reaction at the moment of the injection.

Fear reaction the day after vaccination

Vaccination method is a strong determinant of the fear reaction that the sows show the day after the vaccination. One third of the sows vaccinated with the IM injection exhibited a total withdrawal from the observer 24 hours after vaccination, while being curious and friendly the day before. Such change in fearful reaction was not observed in sows vaccinated with IDAL.

Physiological biomarkers

C-Reactive Protein (CRP) and Haptoglobin (Hp) are two Acute Phase Proteins (APPs) that change considerably upon inflammatory stimulus and that can serve as biomarkers of acute inflammation one day after vaccine administration. Piglets from the IM group presented significantly higher levels of CRP and Hp 28 hours after vaccination compared with the IDAL and the control groups. Levels of CRP and Hp in IM vaccinated piglets were 2.1 and 1.6 times the value observed in IDAL piglets. Therefore, the inflammation caused by IM compared to IDAL vaccination resulted in higher levels of CRP and Hp 28 hours after vaccination. Levels of CRP tended to be higher in IM vaccinated sows with a 1.7 times higher value than IDAL sows 24 hours post-vaccination. No significant differences were observed in Hp levels in sows. The sympathetic adrenomedullary (SAM) system and the Hypothalamic-Pituitary axis (HPA) play a key role in the stress response. Salivary Chromogranin-A (CgA) is a reliable alternative to catecholamines for monitoring SAM activity. CgA tended to increase in IM vaccinated sows. CgA is considered a marker of acute stress and increased CgA levels have been reported in pigs during restraint and after isolation and regrouping. Increased concentrations of CgA in IM sows may either reflect an acute stress response related to the management procedure and increased cardiovascular activity or to a possible metabolic change produced by the acute pain reaction to the injection. In piglets, CgA levels were not affected by the vaccination method. Salivary cortisol indicates activity of the HPA axis in response to different stressors in pigs. No significant changes in salivary cortisol were measured, indicating that HPA axis has not been activated by the vaccination procedure. Based on our results, salivary cortisol may not be sensitive enough to measure acute fear reaction after vaccination.

Skin alteration at the injection site

Around 50% of the sows presented a skin reaction at the injection site 28 hours and 52 hours following the IDAL vaccination. This reaction was described as a reddish inflammation of 0.5cm diameter. The skin reaction was not more visible 28 days post-vaccination in IDAL sows. On the contrary, 9% of sows vaccinated with the IM method developed a skin reaction after 28 hours but this percentage increased to 26% by 28 days. This was described as a 3cm in diameter abscess, sometimes with open lesion. Piglets vaccinated with the needle-free IDAL device had a higher prevalence of skin reaction at the injection site than pigs vaccinated with a needle. This reaction was described as a surface reaction of 0.5cm diameter detected only through palpation at the injection site.

Average daily gain (ADG)

Piglets were weighed on day 0 (the day of vaccination treatment) and day +21 after vaccination. ADG was similar between the pigs vaccinated intramuscularly and with the IDAL as well as with the control group (Control 440g/day vs. IDAL 430g/day vs. IM 440g/day; P-value=0.45). The method of vaccination and the vaccination by itself did not alter the ADG.

Conclusion

The above mentioned studies support that intradermal vaccination with the needle-free IDAL is a very promising strategy that improves the welfare of gestating sows and piglets during vaccination, while also maintaining vaccine efficacy.

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Welfare benefits of intradermal vaccination

by Göller Manuel, Fels Michaela, Kemper Nicole, Institute of Animal Hygiene, Animal Welfare and Farm Animal Behaviour, University of Veterinary Medicine Hannover, Foundation, Bischofsholer Damm 15, 30173 Hannover, Germany.

The aim of this study was to investigate possible welfare aspects of IDAL vaccination in piglets.Therefore, piglets were vaccinated either with IDAL or with a conventional needle and syringe, and local reactions, animal behaviour and performance data were assessed.

Material and methods

The study was done in a German pig farm with 240 sows (BHZP Viktoria and Danbred), managed in a three-week-rhythm with a suckling period of 28 days. A total of 672 suckling piglets from three batches were included. Seven day old piglets were vaccinated either with Porcilis M Hyo ID ONCE intradermal (n=338; off label use) or with Stellamune One (Zoetis Deutschland GmbH, Berlin, Deutschland) intramuscularly (n=334; control group).

Piglets were weighed individually one day before vaccination and eight days later. The injection site was evaluated for three days each post-vaccination as well as on day seven post-vaccination, and the size of swelling was scored on a scale from 0-6, ranging from 'no swelling' to 'dove egg size'. One day before and eight days after vaccination, an overall health/skin lesion assessment was done that included rectal body temperature and an evaluation of the skin lesions on all body, resulting in a cumulative lesion score for each piglet.

To assess the piglets' behaviour, twelve litters in total were analysed. Two litters vaccinated intradermally and control litters per batch were monitored by video cameras over 10 days, starting two days before vaccination. Videos were analysed in time intervals of five minutes between 6.00 and 10.00, 13.00 and 17.00, and 19.00 and 21.00 for the number of piglets lying/resting, standing, walking, suckling, and showing social interaction. In addition, the time needed for each vaccination was recorded via an electronic time clock.

All data was statistically analysed with the IBM SPSS Statistics software, version 22. Results were considered statistically significant if the related P-values were less than 0.05.

Results and discussion

Daily weight gain was not significantly different between piglets vaccinated with IDAL (247g/d) or with needle and syringe (258g/d). On day one post-vaccination, 71.3% of the control piglets had no swelling at the injection site versus 2.7% of the IDAL pigs (Table 1).

On day seven post-vaccination, hardly any swelling or rubor was observed (Table 2).

Table. 1. Evaluation of injection site: day one post vaccination.

	No swelling (%)	<Pea (%)	Pea (%)	Bean (%)	Hazelnut (%)	Dove egg (%)
IDAL group	2.7	11.0	38.8	21.3	16.9	9.5
Control group	71.3	20.7	7.2	0.9	0	0

	No swelling (%)	<Pea (%)	Pea (%)	Bean (%)	Hazelnut (%)	Dove egg (%)
IDAL group	65.6	22.2	7.8	2.4	1.8	0.3
Control group	96.1	3.9	0	0	0	0

Table. 2. Evaluation of injection site: day seven post vaccination.

The overall scoring of skin lesions on different body areas was not different between the two groups with low cumulative lesion scores. In addition, vaccination method did not have any effect on average body temperature in IDAL vaccinated piglets (38.9°C) or control piglets (39.0°C).

Video analyses revealed that on the day of vaccination, control piglets laid down significantly more often after vaccination, stood and walked less, suckled less and were less social than those vaccinated with IDAL (Fig. 1).

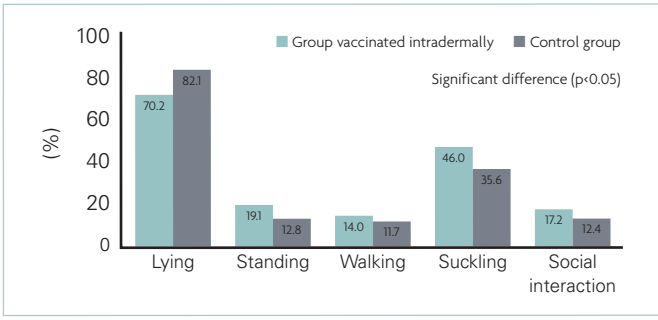

Fig. 1. Behaviour analyses on the day after vaccination.

On day one after vaccination, they still suckled significantly less frequently, while all other behaviours were aligned to the level of the IDAL group. In contrast, IDAL piglets were more active and suckled more often. As lower activity in piglets is related to stress and pain, it can be concluded that IDAL vaccination possibly reduces stress, resulting in sufficient milk intake. The IDAL vaccination took 11 seconds, while needle and syringe vaccination took 17 seconds per piglet and vaccination dose, a difference that may be meaningful for larger farms.

Conclusion

In conclusion, IDAL vaccination in suckling piglets is less stressful than vaccination with needle and syringe. The study results support that IDAL vaccination may be a promising alternative from an animal welfare point of view.

Software and biosecurity

A collaborative and effective effort to optimise biosecurity worldwide

www.msd-animal-health.com

It has been one year since B-eSecure was launched into the world. Due to the great partnership and teamwork at both MSD Animal Health and PigCHAMP Pro Europe, B-eSecure is already a great success: at the moment, more than 15 countries, 50,000 sows and 50 people are involved in this unique biosecurity project. What is the story behind this special collaboration? We talked to María Aparicio from PigCHAMP Pro Europe to find out.

Leading swine software

For over 25 years, PigCHAMP has been the leading swine software company for data collection, management and interpretation. PigCHAMP Pro Europe has revolutionised how pork producers think about data collection and analysis. A few years back, the idea emerged of developing a biosecurity program.

Determine and quantify farm staff movements

"PigCHAMP has been giving training in biosecurity for a long time. We were able to provide insight into farm movements, but we couldn't check whether our recommendations were actually being followed. That's when we started to consider how we could determine and quantify farm staff movements. After testing many options, we developed PRRSons, later renamed B-eSecure," María explains.

Teamwork leads to innovation

B-eSecure is an electronic system that can track people's movements on farms and visualise the effects of biosecurity improvement on health and production results. "With MSD Animal Health as our partner, we were able to run a large pilot trial worldwide and make the system even better and faster. Teamwork leads to innovation. B-eSecure is a collaborative and effective effort to optimise biosecurity worldwide."

Patience is key

María and her team had to deal with several challenges. "Some farm workers doubted the biosecurity system at first, because they did not understand that the virus could be carried on their clothes. And once they understood the process, they thought that they could never have lunch at the same time with other colleagues working in a different area of the farm with a different health status. But patience is key. Nowadays the responses are very positive from both farm staff and veterinarians. Comments like 'I understand certain diseases far better now' and 'I finally see why veterinarians ask for certain things' really encourage us. Biosecurity is still a major concern for the swine industry. Effectively managing biosecurity on the farm is crucial for the business. B-eSecure makes it possible to transform 'gut feelings', emotions and assumptions into metrics, combining animal health, performance and human resources. It is a breakthrough in prevention and swine health. And it is still improving. Developments like real-time alerts and more fluent connections between devices are on the way."

The potential of big data is incredible

"With B-eSecure, we can now align various mindsets," Maria added. "People from different disciplines can work together, like veterinarians, agronomists, engineers, programmers and producers. And maybe even more importantly: for the first time we can correlate wrong staff movements with viraemia on farms. The potential of big data is incredible. We are only at the beginning of this biosecurity chapter in history."

Members of the B-eSecure project in Mexico.

MSD Animal Health