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PAPER

Use of injectable transponders for the identification and traceability of pigs

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Abstract

Individual identification in pigs is a key point for management, traceability and trade control. The aim of this experiment was to study retention rate and functionality of electronic identification systems in pigs, injected in different sites, evaluate traceability of animals and highlight histopathological alterations of tissues in different inoculation sites.

A total of 60 crossbred piglets were used to compare different transponder inoculation sites. One group (15 piglets) was identified only by plastic ear-tags, while three groups were identified by passive injectable transponders (PIT), with different inoculation sites. Pigs were slaughtered in two different moments, in order to evaluate injection sites, macroscopically and histologically, either 50 days after injection or at a normal slaughtering weight. In general, no apparent animal health problems were observed the day after the injection or during the control readings performed during the experiment. Intraperitoneal localization gave excellent results in term of readability until the slaughter time. Transponders at the slaughter line were always recovered in the viscera tray, as they were found loose in the peritoneal cavity. In some cases, they were found on the carcasses, attached to the peritoneum. In those cases a sample of peritoneal tissue was collected for histological examination. A reparative chronic reaction with moderate and multifocal fibrosis and neoformed vessels associated to multifocal and mild lymphoplasmacytic infiltrate were detected. In one case (6.7%) the transponder was found on the visceral side of the liver and the histological examination highlighted a localized superficial hepatic atrophy by compression.

Retroauricolar site of injection gave lower readability results, as 2 transponders (13.3%) were no more readable during the first month after injection. No lesions were found with this inoculation site.

PIT injected in the perineal region were operative until slaughter time. Recovery procedures at the slaughterhouse were simple for animals slaughtered at a low weight, but much more difficult in the case of heavy pigs. Moreover, in three cases (20%), PITs were no more in the subcutaneous tissue but had an intramuscular localization. The histological examination of the muscles revealed a chronic reparative process.

In our experiment, injectable transponders in the intraperitoneal position provided the best identification system for pigs. Histopathological examination revealed only local reparative processes in the tissues interested by PIT contact, and no other pathological changes.

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Introduction

Individual identification in pigs is a key point for management, traceability and trade control. Conventional identification methods used to identify pigs (i.e., ear-notching, ear-tags and tattoos) are not sufficiently efficient (Stärk *et al.,* 1998) to reach the threshold of 99% (at 3 months) and 98% (at 12 months) retention rates approved by the International Committee for Animal Recording (ICAR, 2003). The major reasons of this inefficiency are losses, code erasing, short reading distances, transcription mistakes and fraud (Caja *et al.,* 2001, 2005). Electronic identification using passive transponders could be an alternative and it has already been applied for swine management and feeding (Huiskes, 1991; Blair *et al.,* 1994). Electronic devices used in pigs include collars, ear-tags and injectable transponders (Lambooij and Merks, 1989; Lambooij, 1992; Lammers *et al.,* 1995). Slaughtering procedures for pigs, using electroshock, hot water and a high line speed, put at risk the retention and recovery of each kind of identifiers in the slaughterhouse. Moreover, electronic devices must remain functional at the slaughter line and the removal from the carcass has to be performed in less than 5 seconds in order to be acceptable (Merks and Lamboij, 1990). The aim of this experiment was to study the retention rate and functionality of electronic identification systems in pigs, injected in different sites, to evaluate the traceability of animals and the histopathological alterations of tissues in different inoculation sites.

Materials and Methods

Animals and management

A total of 60 newborn crossbred piglets were used to compare different transponder inoculation sites. One group (15 piglets) was identified only by plastic ear-tags; and three groups (15 piglets each) were identified by passive injectable transponders (PIT) with different inoculation sites. Two slaughtering time were individuated: one group of animal was slaughtered at 20 kg of weight (to evaluate "short term" histological alteration) and the other animals were slaughtered at the usual weight to evaluate histopathological alteration in the "heavy pig". Piglets were born (day 0) and reared in a didactical farm with a closed-cycle (CISRA - Grugliasco, Italy). Farrowing crates (1.5×2.5 m) consisted of a farrowing stall for untied sows with plastic slatted flooring. The farrowing barn had a controlled temperature (21 to 28°C). Piglets creep area had a heating plate kept at 28°C. Both the sow and piglets had free access to water through nipple drinkers. Piglets were injected on day 2 with iron (2 mL Endofer - Fatro Spa) and were castrated on day 15. They were provided a concentrate *ad libitum* starting from day 12. Sows were checked daily for signs of farrowing problems and dead piglets were removed. Piglets were weaned on day 28 and each group was divided in 4 different pens. Pigs were checked once daily and fed twice daily with a fattening concentrate. Four pigs per group were slaughtered at a weight of 20 kg for an early histological evaluation of the inoculation site. The remaining pigs were slaughtered with a market weight of about 110-150 kg. Transport to the abattoir was conducted according to European Commission regulations. The distance to the abattoir was 50 km and the journey took approximately 45 min. Pigs were slaughtered by electric stunning, scalding, dehairing, flaming, evisceration and carcass processing. Carcasses were immediately chilled and stored in a cold room (4°C) for approximately 12 h.

Injectable transponders, injection procedures and ear-tags

Two different PITs were chosen (one with a 32 mm length by Rumitag SL - Barcelona, Spain - the other one by AEG ID - Ulm, Germany) (Table 1). Serial numbers of injectable transponders agreed with ISO standard 11784 (ISO, 1996) and included the ICAR manufacturer codes (available on the ICAR website). Transponders were inoculated at day 8±2 into three body sites: s.c. in the auricle base of the ear (n=15), intraperitoneally (n=15) and in the perineum area (n=15). The control group (n=15) was identified only by plastic ear-tag. Plastic ear-tags were applied as well to pigs of all other groups. Before each injection, performed in the farrowing pens, the relevant body site was disinfected with a iodine solution. To perform the auricle base injection, an assistant immobilized the piglets and the operator injected the transponder into the auricle base of the left ear in a dorso-ventral direction, according to the procedure described by Lambooij (1992). To perform the intraperitoneal injection, an assistant placed the piglet on its back and immobilized it; the operator injected the transponder, approximately 2 cm caudally to the navel, in an inclined direction toward the abdominal cavity. After the needle traversed the abdominal wall, the injection direction changed to perpendicular and the transponder was released. Finally, for the perineal injection, the transponder was placed in the perineal region between the anus and the ischiatic tuberosity. The transponders were injected using different injectors, according to their size. Single-shot injectors were used for transponders produced by AEG-ID while an injector with interchangeable needles was used for transponders of Rumitag.

Table 1. Passive injectable transponders technical data.

	Type 1	Type 2
Length	32 mm	10 mm
Manufacturing company	Rumitag SL (Barcelona, Spain)	AEG ID (Ulm, Germany)
Readibility distance	Until 1 m	Until 50 cm
Coat composition	Biomedical glass	Biomedical glass

The control group was tagged in the right ear with plastic ear-tags only, in order to study their retention rate in comparison with injectable transponders. Ear-tags were applied using the same tag applicator mentioned above. Plastic ear-tags were circular and featuring a different color for each group (28 mm diameter, by Allflex).

Reading and recovery at slaughtering

The PITs were checked before and immediately after injection using two different hand-held transceivers (by Rumitag and AEG ID). The time required for the injection (time between the identification of two animals) was recorded. Reading performances were evaluated weekly until the day before slaughtering.

Pigs were slaughtered in two different times, in order to evaluate injection sites, macroscopically and histologically, either a short time after injection or at a normal slaughtering weight. The short term evaluation was done by slaughtering 4 pigs for each group when they reached a weight of about 20 kg. All the other animals were slaughtered at a weight of 110-150 kg. At the slaughter line the transponders were individuated by the transceivers. Intraperitoneal PITs were recovered when the operator removed the gastrointestinal tract from the animal and placed it in the viscera tray. PIT in the ear and in the perineum areas were recovered before cooling but after the slaughter line.

When a lesion was detected in the inoculation site, the area interested by the lesion was isolated and sampled for microscopic examination, fixed in 10% buffered formalin for 24-48 hours and processed for routine paraffin embedding. Sections of 3 μm thickness were stained with hematoxylin and eosin (HE).

Statistical analysis

Different inoculation sites were compared by software EpiInfo 6 for presence of lesions and for readability with a χ^2 test (P<0.05).

Results and discussion

In general, no apparent health problems were observed the day after the injection or during the control readings performed during the experiment. These findings agree with those of Conill *et al.* (2000, 2002) and Caja *et al.* (2005), who found no negative effects in cattle, lambs and pigs in similar experiments. Only 1 piglet died (perineal injection group) in our experiment, but the necropsy confirmed that the cause of death was not related to transponder injection. Overall, mortality was lower compared to the reference values of 15% (Whittemore, 1993), probably due to the reduced number of animals present in the farm.

After PIT injection, no inflammatory reactions or abscesses were found; this is in according with Caja *et al.* (2005), but in contrasts with the results obtained by Lambooij *et al.* (1995), who found that 0,6% of pigs had an inflammatory reaction in the injection area three weeks after injection. No reactions were found after ear-tag application either, unlike the results obtained by Stärk *et al.* (1998), where 18.9% of sows had an adverse reaction to tag application, but it is in according with Caja *et al.* (2005) who reported no adverse effects after ear-tag application.

Intraperitoneal injection

This localization gave excellent results in term of readability until the slaughter time, as 100% of intraperitoneal PITs was readable until slaughtering. In the peritoneal cavity the transponder is protected and enveloped by the abdominal viscera. Caja *et al.* (2005) reported no breakages, while a percentage of 0.4% of losses was observed. Transponders at the slaughter line were mainly recovered in the viscera tray, because they were found loose in the peritoneal cavity. In three cases, they were found on the carcasses, attached to the peritoneum and a sample of peritoneal tissue was collected for histological examination. A reparative chronic reaction with moderate and multifocal fibrosis and neoformed vessels (granulation vascular tissue) associated to multifocal

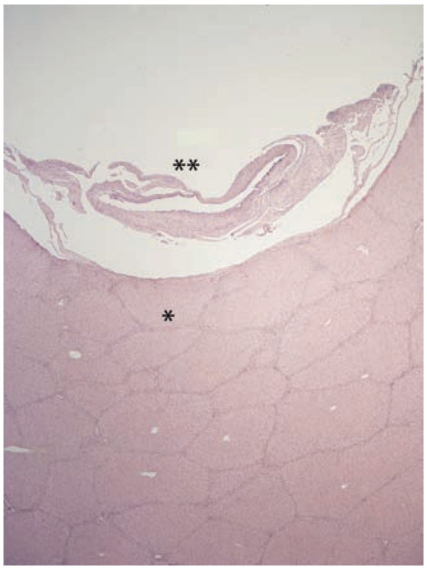

Figure 1. Normal hepatic parenchyma (*) with atrophy by compression and moderate peritoneal reaction (**) (HE, 2x).

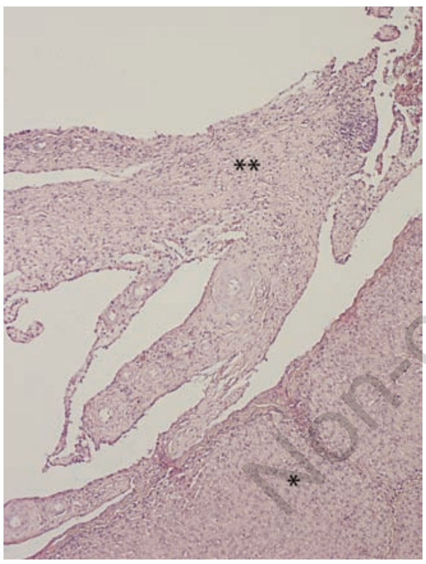

Figure 2. Hepatic parenchyma (*), particular of the Figure 1: fibrotic tissue and neoformed vessels (**) (HE, 10x).

and mild lymphoplasmacytic infiltrate were detected. In one case (6.7%) the transponder was found on the visceral side of the liver and the histological examination highlighted a localized superficial haepatic atrophy by compression (Figures 1 and 2).

The recovery time was generally short, but in one case the transponder fell down in the drain water well and the slaughterhouse staff did the recovery at the end of the day.

Retroauricolar injection

This site of injection gave lower readability results, because 2 transponders (13.3%) were no more readable during the first month after injection (one signal was no more present at day 2 and one at day 30 after injection). The two animals were examined at the slaughter line by a brilliance identificator, in order to evaluate if the PIT was either on the animal, even broken, or got lost. In both cases, PITs were not found on the animal.

This is in according with Caja *et al.* (2005), who reported that PIT losses in the auricle base could occur during the first month after injection; however, in that study a percentage of 40.8% was found.

The transponder recovery at the slaughter line was done by cutting the retroauricolar region with 2-3 cuts, if the animal head was not removed (pigs slaughtered at a lower weight), otherwise PIT was recovered from the removed head. The localization of PIT was operator-dependent; some operators cut the head leaving PIT it, while other operators, after cutting the head, left PIT on the carcasses and the recovery was done by trimming neck fat layer. No lesions were found with this inoculation site.

Perineal injection

All PITs injected in this area were operative until slaughter time. Recovery procedures at the slaughterhouse were simple for animals slaughtered at a low weight, but much more difficult in the case of heavy pigs; fat layer in this area was thick and wide fat portions had to be cut compromizing the aspect of the thigh. This has to be considered in a country like Italy where thigh represents the most important commercial portion of pig. Moreover, in three cases (20%), PITs were no more in the subcutaneous tissue, but had an intramuscular localization. The histological examination of the muscles revealed a chronic reparative process.

Plastic ear tags

All the plastic ear-tags used in our experiment remained on the animal until slaughtering. Main problems occurred during slaughtering, as they were almost totally lost in flaming and deharing procedures. Another problem could be the limited information reported on a plastic ear-tag. In our experiment, ear-tags reported the group (different color) and the number of animal; this last information faded by time passing and mistakes could be frequent.

In our experiment no transponder electronic failure was reported, while Caja *et al.* (2005) reported a percentage of 0.5% of electronic failure in the auricle base injection; neither we observed any losses of transponder or tags during transportation to the slaughterhouse house. Statistical evaluation gave no differences among sites concerning presence of lesions or loss of transponder, but the samples number must be considered in this respect.

Conclusions

In our experiment, the tested injection site gave similar results for readability, PIT retention and histopathological changes but studies with a larger number of animals are necessary. In our opinion, intraperitoneal position provided better result because no intervention on the carcasses is required to recover PIT. Considering this parameter, the worst localization is the perineal site. This method meets the requirements of an identification system for pigs that is permanent and unique, does not produce apparent disturbances to the animals at application and is tamper-proof. Histopathological examination revealed only local reparative processes in the tissues interested by PIT contact, and no other pathological changes.

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