Passive antibody therapy revisited in light of the increasing antibiotic resistance: serum prepared within a farm reduces mortality of dystrophic neonate piglets

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SUMMARY
An attempt was made to reevaluate possibilities of passive antibody therapy in veterinary medicine as alternative for antibiotic usage since undesired after-effects of the latter became evident. A narrow, but problematic area of animal husbandry was chosen and a trial was conducted to compare the efficacy of swine serum prepared within a farm coupled with good supervision (study group) versus good supervision only (control group) in combat with infectious diseases in dystrophic neonate piglets. 374 piglets (224 study and 150 control ones) were involved in the trial and application of antibiotics in study groups was completely excluded. It was shown that such a serum turned out to be an effective measure for increasing dystrophic piglet survival. When used for prophylaxis and treatment of infectious diseases it reduced the mortality rate of low-viability neonates for about 20% in both cases (statistically significant, P < 0.01). Production and application of the serum within a farm was cost-effective.

KEY-WORDS: antibiotic resistance - serum - therapy - farm - mortality reducing - neonate piglet.

Résumé
Utilisation d’un immunsérum préparé à la ferme pour réduire la mortalité des porcelets. Une alternative à l’utilisation des antibiotiques. Par T. NORMANTIENĖ, V. ŽUKAITĖ et G.A. BIZIULEVIČIUS.

Afin de réduire la mortalité des porcelets, les auteurs de cette étude envisagent l’utilisation de l’immunité passive comme une alternative à l’utilisation des antibiotiques. Trois cent soixante-quatorze porcelets dont 150 animaux témoins, ne recevant aucun antibiotique, ont fait l’objet de cette étude. Les 224 animaux ayant reçu un immunsérum, préparé à la ferme, à titre prophylactique ou thérapeutique, présentent un taux de mortalité inférieur de 20% par rapport aux animaux témoins. Cette technique s’avère efficace et rentable.

MOTS-CLÉS : immunité passive - résistance aux antibiotiques - traitement - porcelets.

Introduction
Recently quite a number of articles appeared [6, 9,11,16, 24, 27-32, 34-36] alarming the global community about the spread of antibiotic-resistant pathogens in veterinary medicine and about the implications of antibiotic usage in animals for public health. Slaughterhouse staff and veterinarians are considered to be a possible risk group [4, 21-23, 26]. Those who are interested in the future of both human and animal health aim at new strategies that will diminish the inappropriate and excessive use of antibiotics, including development of alternative therapies such as probiotics, antibody-based products and immunomodulators [1-3, 8,14, 15, 18, 19, 38]. Some old methodologies of combating infectious diseases are revisited, an instance being serum therapy.

Large swine-breeding farms (complexes) are often characterized by a high death-rate (50% and more) of neonates [10]. The high density of animals, the worsening of hygienic and sanitary conditions, inadequate management cause metabolic disorders in sows, which have an impact on foetal deve-
lompment [12]. Piglets are born weak, they become susceptible to mixed (bacterial, fungal, viral) infections [17]. Antibiotic-resistant bacterial pathogens are of special importance to neonate [20, 37].

In such a situation immunological protection of newborn piglets in regard to infectious diseases is very important. Two different measures can be taken. First, vaccination of sows with consequent delivery of specific antibodies to neonate via the colostrum. Second, administering specially prepared broad-spectrum action (heterologous) immune sera directly to neonate piglets within the first few days of their lives. Even if active or passive antibody therapy is applied, the preparations obtained from bioenterprises do not always allow to achieve the desired results because the strains of microorganisms causing piglet diseases that prevail in several farms are not identical to the strains used for the production of vaccines and sera in industry.

On the territory of the former Soviet Union, in large swine-breeding complexes for some years alogene immune swine serum was produced according to the principle 'farm-production-farm' [33]. The principle implies the production of the serum from the blood of adult swine, grown in a specific farm, and its application in the same farm for the prophylaxis and treatment of neonate piglets. Thus, it seems that non-specific immune serum becomes specific in regard to animals of that farm.

The application of such serum was a success, but low-viability piglets, referred to as 'dystrophics', were traditionally culled or left on their own without immunological support and proper supervision. Most of them died within a few days or even hours. Therefore, the objective of this trial was to determine if immune serum prepared within a farm coupled with up-to-date supervision is effective for increasing dystrophic piglet survival.

Materials and methods

Experimental protocols in the form as described below were coordinated with the State Veterinary Service of Lithuania. Moreover, criteria for selection of low-viability piglets, application of antibiotics in treatment control group and otherwise in prophylaxis control group, efficacy evaluation (as well as its timing) of serum therapy/prophylaxis as a difference in mortality rates of control and study group animals were recommended by this organization.

The study was carried out on a 1300-sow commercial swine-breeding complex in the suburbs of Vilnius (Lithuania). The serum was prepared according to SMIRNOV et al. [33] within the farm from swine blood taken in the farm slaughterhouse in separate premises with specialized equipment. The production cycle included operations of blood clot formation, removal of a clot, separation of other ballast substances, preservation of the serum, germ filtration, packaging and quality control. The finished serum was stored in refrigerator at 4°C and warmed up till body temperature before application.

Low-viability German-Swedish Landrace and Lithuanian Large White crossbred piglets were used for the experiment and were supervised as recommended by HOLYOAKE et al. [13]. Piglets were placed in heated cribs away from sows, fed with a total of 100 ml of colostrum at 3-h intervals using a stomach tube and taken back to the sows on the subjective assessment that they were viable and then managed routinely. Litters of 12 or more piglets were 'split-suckled' or 'cross-fostered'. At 3 days of age piglets were treated with an 4 ml intramuscular injection of iron dextran coupled with vitamin B to prevent anaemia.

The first part of the experiment comprised 195 piglets with no signs of infection pursuing the aim of determining the prophylactic efficacy of the serum. Piglets were randomly divided into two groups - one study and one control - and marked differently. The study group piglets (n = 120) at 2 days of age were administered 5 ml of the serum per kg of body weight intramuscularly. The control group piglets (n = 75) remained without immunological support. No other antimicrobial medication was used for the piglets of both groups until the end of the experiment, i.e. for two months, even if they caught a disease.

For the determination of the therapeutic efficacy of the serum (second part of the experiment) 179 piglets, in which the signs of infection were noticed within the first week of lives, were used. Subdivision into groups was random and two more different markings for piglets were introduced. The study group piglets (n = 104) were immediately administered 5 ml of the serum per kg of body weight intramuscularly and injections were repeated after 1 and 3 days. The control group piglets (n = 75) were treated in a usual way with oral antibiotics [20]. Fluids were administered to dehydrated piglets orally.

Chi-square test was used to evaluate the significant differences between the mortality rates of piglets of the study and control groups. P < 0.01 was considered statistically significant.

Results

The results presented in Table I show that the swine serum prepared within the farm turned out to be an effective measure for increasing dystrophic piglet survival. When used in couple with good supervision for prophylaxis or treatment of infectious diseases it reduced the mortality rate of low-viability neonates for about 20% in both cases (statistically significant, P < 0.01).

Discussion

According to FRASER et al. [12] once the piglet is born, its survival during the first few days depends on 3 major factors: 1) adequate intake of energy; 2) suitable environmental temperature; and 3) immunity to intestinal colibacillosis, the major infectious cause of diarrhea in neonate piglets. Good supervision techniques described by HOLYOAKE et al. [13], fulfilling the requirements of the first two items of...
this postulate, gave us a chance to reduce perinatal piglet mortality (it has already been mentioned, that almost all dystrophic piglets die without adequate supervision and immunological support) twice. The beneficial effect of iron dextran, included in these techniques, and vitamin B complex for the prevention of anaemia in piglets was recently once more confirmed by DEY et al. [7].

Successful application of the swine serum prepared within the farm facilitated the reduction of mortality rate for 20 % more (statistically significant, P < 0.01) and this may be attributed to the third statement of the postulate. One more advantage of the serum is that in this case antibiotics was excluded. A strong emphasis on undesirable after-effects of these substances was made in the Introduction to this paper. It must be also mentioned that the serum prepared in such a way was really specific for that farm. When it was sent to be tested in another region of Lithuania the results were negligible.

OTT et al. [25] proposed a mathematical model which shows how many additional resources can be applied to prevent preweaning piglet mortality. On a per piglet born alive basis the model estimates that producers could afford to spend USD 1.42 to eliminate all mortality. Our calculations show that resources needed for the production and application of swine serum within a farm are markedly (approx. 50 %) below this quantity.

All laid out in this paper speaks for the application of passive antibody therapy in this narrow area of animal husbandry. Recently serum therapy was revisited in regard to humans [5]. We may have come to the point of applying the idea to animals.

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References


