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Full Length Research Paper

Passive and active immunity against parvovirus infection in piglets

Nenad Stojanac*, Mladen Gagrčin, Ognjen Stevančević, Ivan Stančić and Aleksandar Potkonjak

Faculty of Agriculture, Department of Veterinary Medicine, University of Novi Sad, Serbia.

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The aim of this study was to come to a closer understanding of the origination, dynamics of movement and cessation of colostral immunity to parvovirus infection in swine (PPV) on the basis of an analysis of antibody titres in the blood serum of piglets in their first 6 months. On the third day of life in the blood serum of newborn piglets, an average antibody titer of 13.37 was recorded. An antibody level of 13.30 was maintained until the 10th day of life, when it started to decline to 12.02 on the seventeenth and to 11.80 on the twenty-fourth day of life. A seronegative result was ascertained on the 38th and 45th day of life (8.40 and 5.48). On the 55th day of life, the titer increased to 10.86 and slowly continued to rise to 11.61 on the 180th day of life. Because negative results are the sign of a complete catabolism of colostral antibodies whose absorption was completed in the first 2 to 3 days of life, the antibodies recorded on the 55th day are to be considered as a result of active immunological reaction formed between 31st and 55th day of life. The research was done on 60 piglets descending from vaccinated mothers and it was expected of the piglets to obtain enough immunity through colostrum which would protect them against PPV infection until they developed their own immunological response. On the basis of the given results, we conclude that colostral immunity to parvovirus infection in swine lasts for about one month and that antibodies found in the blood serum of piglets after the first month of life are a result of the activation of the immune system.

Key words: Porcine parvovirus, colostral immunity, reproductive efficiency, antibody.

INTRODUCTION

Porcine parvovirus (PPV) infection is widely spread in swine around the world and has an enzootic character. The virus attacks swine at all ages and the most endangered categories are gilts before insemination due to the disappearance of passive immunity and of inadequately developed active immunity (Mengeling, 2006). Parvovirus infection is constantly present in Serbia, especially in herds of clinically healthy swine in intensive breeding in the form of a persistent and in-apparent infection (Došen et al., 2000). Porcine parvovirus infection lowers reproductive efficiency which puts into question the continuity, amount, and feasibility of pig production in Serbia. Literature duly suggests the importance of the diagnosis of swine infection caused by parvovirus and the implementation of immunoprevention in order to inhibit its spread (Antonis et al., 2006; Oravainen et al., 2006).

For these reasons, etiology, pathogenesis, and the route of the transmission of parvovirus infection in swine have been studied by many authors (Clark, 1996; Mengeling et al., 2000; Rogan et al., 2002), with special emphasis on the investigation of a protective character of immunity achieved with seropositive and persistently infected swine without the clinical manifestation of the symptoms of the disease after vaccination with inactive vaccine against parvovirus, and the persistency of specific maternal antibodies in their piglets. Newborn piglets are not protected against parvovirus infection because the specific maternal antibodies are only absorbed through colostrum in the first hours of life (Dividich, 2007).

Colostrum is the only source of antibodies for piglets (Damm et al., 2002; Rooke et al., 2003), because many

*Corresponding author. E-mail: stojanac.n@gmail.com. Tel: +381638526510.

of the layered structures of the placenta do not allow transplacental transmission of antibodies against parvovirus from mother onto fetus, whereas pathogenic agents easily pass the placenta. The aim of this research was to follow immunity formation (active and passive) in piglets from the day they were born up until they were 6 months old. Having in mind the data given by many authors that colostral immunity with parvoviral infections may last up to 5 months (Mengeling et al., 1999; Fenati et al., 2009), the main postulate about this type of immunity is a natural passive immunity whose effectors are synthesized in another organism of the same species. The carriers of this immunity are immunoglobulins of class G (IgG). Half life of these immunoglobulins is 15 days, which results in colostral immunity lasting for about 30 days, regardless of their concentration in colostrum itself. Hence, we thought that the reasons for finding antibodies in blood serum of 5 months old piglets have to be searched for elsewhere. On the basis of this, it was decided to study the onset, dynamics of movement and ending of colostrum immunity in pigs.

MATERIALS AND METHODS

Experimental animals

The experiment was performed on a pig farm, with a capacity of 2500 sows, with an intensive way of keeping the pigs infected with PPV enclosed. The experiment was performed on 60 piglets originating from mothers (5 gilts and 5 sows) of the breeds Swedish Landras hybrid (F1), Large Yorkshire, and Swedish Landrace. All experimental animals were clinically healthy and in good condition. From every mother, six piglets were randomly chosen for monitoring of the onset, development and length of passive and active immunity to parvovirus infection. During the experiment, a few piglets died, so the number of researched piglets dropped in time. All the piglets had tags on their ears and a tattooed number.

Blood sampling was performed on day 0, 3, 10, 17, 24, 31, 38, 45, 55, 65, 100, 130 and 180 of life. Blood was taken by the puncture of the brachiocephalic plexus of the piglets.

Immunization of mothers

A regular vaccination against PPV infection of all the mothers was performed on the farm. Sows were vaccinated with inactivated monovalent vaccine against swine parvovirus according to the manufacturer's instructions (Intervet, Holland) two weeks before insemination, while gilts were vaccinated twice, 8 and 2 weeks prior to insemination. The vaccine had inactivated swine parvovirus, subtype 014, which was diluted in water adjuvance. The vaccine was applied in 2 ml dosages, deeply intramuscularly, behind the ear. Two milliliter dosage contained >2560 HA units.

Determination of the presence of antibodies

Antibodies against parvovirus were detected with a HI test (Ašanin et al., 2006), with slight modifications: only guinea pig erythrocytes and V-bottom microplates were used and no bovine serum albumin was used for a clearer end-point. Animals were considered to have low antibody levels when HI titres were ≤1:512. Titres >1:512 were considered high. The Scientific Veterinary Institute, Novi Sad diagnostic guidelines for PPV viruses, based on evaluations of vaccinated animals and field cases, are as follows: antibody titres ≤1:8 indicate that the animal has not seroconverted, 1:16 to 1:512 indicate intermediate seroconversion, and titres beyond this represent a high level of antibodies.

Statistical analyses

During the processing of the results, antibody values characteristic of PPV were calculated on logarithm values - $\log_2$. After $\log_2$ results, titres ≤1:512, were considered negative and were given 0, $\log_2$ titre 1:512 was 9, 1:1024 was 10, 1:2048 was 11, 1:4096 was 12, 1:8192 was 13 and 1:16384 was 14. After processing the results, and on the basis of referent values administered by accredited laboratories for testing, the obtained antibody titer results characteristic for PPV in blood serum of examined animals with the value less than 9, were considered as seronegative results. For the evaluation of the results, statistical methods were used: average and interval variation. Data handling was done in Excel 2007. The results were transformed to logarithmic values with the base logarithm 2 ($\log_2$).

RESULTS

The obtained results showed titre values of characteristic antibodies for PPV and represent the diluting of the serum where antibodies were detected, so, there is no unit in which they could be measured. The obtained results of the diluting were transformed into logarithmic values ($\log_2$). Table 1 shows the levels of antibodies specific for PPV in blood serum of newborn piglets. Before the uptake of colostrum, antibodies were not found in any piglet.

In the blood serum of three days old piglets, antibodies specific for PPV were found. A total of 60 blood serum samples were checked, and the defined titre values of specific antibodies ranged between 11 to 14 (Table 2). In three days old piglets, the antibody level was 13.37. With the same 10 days old piglets, an antibody level of 13.30 specific for PPV was diagnosed. In blood serum of 17 days old piglets, the average titer value of antibodies specific for PPV was 12.02, which is a lower level compared to an average level of antibodies specific to PPV in the blood serum of 10 days old piglets (13.30). From the results in Table 2, it can be concluded that an average antibody titer specific for PPV in the blood serum of 24 days old piglets was 11.80. With 31 days old piglets, the determined antibody titer values specific for PPV was 8.70. The antibody titer value characteristic of PPV in blood serum of examined 38 days old piglets was 8.40. In blood serum of 45 days old fatlings, the lowest antibody titre value characteristic of PPV was found, and it measured 5.48. The average value of antibody titer characteristic of PPV with 55 days old fatlings was 10.86. The average antibody titer specific for PPV in blood serum of 65 days old fatlings was 10.63. With 100 days old fatlings, the antibody titre specific for PPV was found

Table 1. Antibody titer specific for PPV in blood serum of piglets.

Titer value	Number of piglets												
	*0	3	10	17	24	31	38	45	55	65	100	130	180
14	0	36	38	7	11	0	0	0	4	2	2	12	3
13	0	14	16	13	8	0	0	0	6	2	4	2	10
12	0	6	4	20	14	2	6	0	5	8	7	1	14
11	0	4	0	14	13	9	7	10	13	15	15	8	9
10	0	0	1	6	13	21	22	10	21	21	9	12	13
9	0	0	0	0	1	21	15	12	8	9	10	15	0
0	60	0	1	0	0	7	10	26	0	0	0	0	0

* Age (days).

Table 2. The average antibody titer values specific for PPV in the blood serum of piglets.

Age (days)	Average	Interval
0	0	0
3	13.37	11-14
10	13.30	0-14
17	12.02	10-14
24	11.80	9-14
31	8.70	0-12
38	8.40	0-12
45	5.48	0-11
55	10.86	9-14
65	10.63	9-14
100	10.83	9-14
130	10.98	9-14
180	11.61	10-14

to be 10.83. The average antibody titer specific for PPV in the population of 130 days old fatlings was 10.98. Within the examined population of 180 days old fatlings, antibody titer specific for PPV was found to be 11.61 (Table 2).

DISCUSSION

Before the uptake of colostrum, antibodies specific for PPV were not diagnosed in the blood serum of any piglet from the vaccinated mothers (Table 1). This indicates no intrauterine infection (Dividich, 2007). The average antibody titer specific for PPV in blood serum of 3 days old piglets was 13.37 which is a very high value and shows the efficiency of the transfer of colostral antibodies from sow to piglet (Damm et al., 2002). Nearly all the identical average antibody titer specific for PPV was diagnosed in the blood serum of 10 days old piglets. Although it is a question of a relatively unexpected occurrence, it is possible that it is the case of a prolonged absorption of colostral immunoglobulins, which, in some cases, can last for 5 days (Rooke et al., 2003). In this period, the first piglets without immunoglobulin appeared (Table 1), which could be connected to immunoglobulins M (IgM) which in a number of cases could be the colostral immune carriers. With 17 days old piglets, the decrease of the antibody titer specific for PPV was noted, compared to the antibody titre with the same piglets seven days before (from 13.30 to 12.02). The drop in antibody titer values of 10% is probably the consequence of the onset of the catabolism of colostral titre antibodies for about 10% (Gagrčin et al., 1989) due to the decreased plasma concentration in a growing piglet (Paul et al., 1981). Antibody titer specific for PPV in blood serum of 45 days old piglets has a tendency to drop, and with 31 days old piglets, an increased number of sero-negative animals occurred. With the same examined 45 days old fatlings, the lowest antibody titer specific for PPV was found to be 5.48. The antibody titer specific for PPV progressively increased from 55 until the 180th day of fatling life. The antibody titer in 55 days old fatlings was 10.86, which is double the value compared to the one gained 10 days earlier. The reason for this abrupt raise of antibodies specific for PPV in the blood serum of fatlings should be sought in the fact that PPV infection of swine is widely spread with clinically healthy swine around the world. Also, PPV is an enzootic infection, permanently present on the territory of Serbia (Došen et al., 2002), especially in clinically healthy swine herds in intensive breeding, in a form of inapparent persistent infection. All this is a consequence that the infection of fatlings whose level of protection from PPV infection was very low when they were 45 days old initiated immunological response which manifested itself with elevation of antibody titer specific for PPV. The results show that up till 45 days of life, piglet catabolism of colostral antibodies occurred, and the passive immunity seized to exist, which is evidenced by the fact that the bearers of passive immunity are immunoglobulin G (IgG) (Gagrčin et al., 1989; Rooke et al., 2003). Half-life of this class of immunoglobulin is 15 days (Jerant-Patic, 2000; Tizard, 2000) which as a consequence has continuation of passive immunity for 3 to 40 days, regardless of their

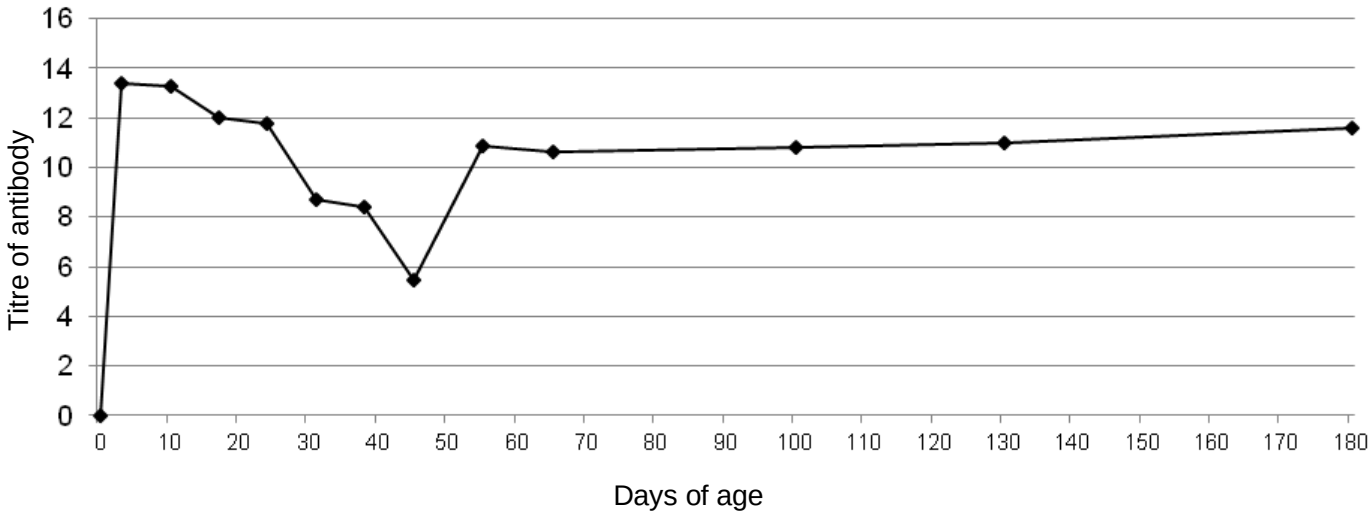

Figure 1. The dynamics of movement of antibody titer values specific for PPV in the blood serum of piglets.

concentration in the colostrum itself.

Considering the data from many authors that colostrum immunity lasts up to 6 months (Gradil et al., 1990; Mengeling et al. 1999; Fenati et al. 2009), the question that arises is “what is the class of immunoglobulin of which the half life would be 3 to 6 months?” Because such an immunoglobulin class has not been determined, the reason for this statement should be sought in the activating of the self immunological response.

In this study, a very high antibody titer specific for PPV in the blood serum of 130 and 180 days old fatlings was found (10.98 and 11.61). This high antibody titer specific for PPV has been confirmed in studies by Mengeling et al. (1999) and Fenati et al. (2009). They administered the findings of a high antibody titer with 3 to 6 months old piglets to passive immunity, that is, to colostral antibodies. The antibody titer specific for PPV in 40 days old piglets dropped to a low level since there was catabolism of colostral antibodies which Gagrčin et al. (1989) explained in their research and which meant termination of passive immunity, upon which the self immune response happened (active immunity) (Figure 1).

REFERENCES

Antonis FGA, Bruschke JMC, Rueda P, Maranga L, Casal JI, Vela C, Hilgers ATL, Belt BGMP, Weerdmeester K, Carrondo JTM, Langeveld PMJ (2006). A novel recombinant virus-like particle vaccine for prevention of porcine parvovirus-induced reproductive failure. Vaccine, 24: 5481-5490.

Ašanin R, Krnjajić D, Milić N (2006). Priručnik sa praktičnim vežbama iz mikrobiologije sa imunologijom. Autorsko izdanje, Beograd. pp. 63-66

Clark LK (1996). Epidemiology and management of selected swine reproductive diseases. Anim. Reprod. Sci. 42:447-454.

Damm IB, Friggens CN, Nielsen J, Ingvarsen LK, Pedersen JL (2002). Factors affecting the transfer of porcine parvovirus antibodies from sow to piglets. J.Vet. Med. Series A, 49(9): p. 487.

Dividich LJ (2007). The issue of colostrums in piglet survival: energy and immunity. Nutri. Biotech. Feed Food Ind. pp. 89-102.

Došen R, Gagrčin M, Prodanov J, Orlić D (2002). Porcine parvovirus infection. Vet. Glasnik, 56(1-2): 13-19.

Fenati M, Armaroli E, Corrain R, Guberti V (2009). Indirect estimation of porcine parvovirus maternal immunity decay in free-living wild boar (*Sus scrofa*) piglets by capture-recapture data. Vet. J. 180(2): 262-264.

Gagrčin M, Popović M, Ćirković D (1989). Some aspects of colostral immunity in piglets against porcine parvovirus infection. Vet. Glasnik 44(7): 587-590.

Gradil CM, Joo HS, Molitor TW (1990). Persistence of porcine parvovirus in swine infected in utero and followed through maturity. J. Vet. Med. B 37: 309-316.

Jerant-Patić V (2000). Viruses today and tomorrow. Med. Pregl. 53(11-12): 547-558.

Mengeling WL (2006). Porcine parvovirus. Diseases of swine, Iowa State University Press, Iowa, pp. 373-386.

Mengeling WL (1999). Porcine parvovirus. Diseases of swine, Iowa State University Press, Iowa, pp. 187-200.

Mengeling LW, Lager MK, Vorwald CA (2000). The effect of porcine parvovirus and porcine reproductive and respiratory syndrome virus on porcine reproductive performance. Anim. Reprod. Sci. 60-61: 199-210.

Oravainen J, Hakala M, Rautiainen E, Veijalainen P, Heinonen M, Tast A, Virolanen JV, Peltoniemi OAT (2006). Parvovirus antibodies in vaccinated gilts in field conditions-results with HI and ELISA tests. Reprod. Dom. Anim. 41: 91-93.

Paul PS, Mengeling WL, Pirtle EC (1981). Duration and biological half-life of passively acquired colostral antibodies to porcine parvovirus. Am. J. Vet. Res. 43:8.

Rogan D, Petrović T, Lazić S (2002). Novija saznanja o parvovirusnim infekcijama svinja, Zbornik referata i kratkih sadržaja, 14. savetovanje veterinara Srbije, Zlatibor, pp. 49-58.

Rooke AJ, Carranca C, Bland MI, Sinclair GA, Ewen M, Bland CVI, Edwards AS (2003). Relationship between passive absorption of immunoglobulin G by the piglet and plasma concentrations of immunoglobulin G at weaning. Livestock Prod. Sci. 81: 223-234.

Tizard IR (2000). Veterinary Immunology. 6th Edition, London, WB Sauders, 89: p. 223.