UDC 619:616.98:578.823.91:636.7:616-085.371

DOI 10.29326/2304-196X-2018-4-27-63-67

IMMUNOPROPHYLAXIS OF CANINE PARVOVIRAL ENTERITIS

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SUMMARY

Data on the specificity of the development of post-vaccination immunity against parvovirus enteritis agent in dogs are summarized and analyzed in the review. The publications were searched for using the following bibliographical and reference databases: Russian Science Citation Index (RSCI), Scopus, Web of Science, Agris, PubMed, as well as Google Scholar search system and the electronic library of theses of the Russian State Library (RSL). Triple vaccination of puppies was found to be the most effective, therewith the puppies shall be last vaccinated at the age of 16-weeks or older. Where necessary, vaccination of 4-week-old puppies and pregnant dogs is allowed. After immunization, the rates of increase in anti-canine parvovirus enteritis antibody titre do not depend on the sex of dogs or vaccine type but can vary depending on age, body weight and the presence of maternal antibodies. The titres of maternal antibodies against canine parvovirus type 2 in newborn puppies demonstrate broad individual invariance. The use of immunomodulators as adjuvants in vaccine composition is proved to be effective to maintain the high titre of antibodies against canine parvovirus type 2 in the post-vaccination period, and the modern DNA-vaccine is a reasonable alternative to conventional vaccination. The probability of adverse reactions resulting from the administration of a combined vaccine containing canine parvovirus enteritis agent antigen is 3.8%; the predisposing risk factors are the following: neutering, low body weight and the age of less than 9 months old. Contemporary vaccines based on NL-35-D CPV-2 strain confer the full protection from other virulent strains of canine parvovirus type 2.

Key words: canine parvovirus enteritis, immunoprophylaxis, vaccination, antibody titer, immunity.

INTRODUCTION

Parvovirus enteritis remains one of the most dangerous and wide spread infectious diseases of dogs associated with high likelihood of lethality in the world. It causes local lesions of gastro-intestinal tract as well as significant systemic endotoxaemia [25].

Canine parvovirus enteritis is caused by canine parvovirus type 2 (CPV-2) with three worldwide circulating variants (CPV-2a, CPV-2b и CPV-2c) having different genetic variability frequency and level that define the virus pathogenic characteristics [18, 29].

Vaccination remains the most important measure in veterinary practice for small animal infectious disease prevention and health protection. Therewith, recommendations for vaccine application have been recently significantly modified [14, 15, 30].

Administration of the combined vaccine against carnivores' diseases results in increase in specific virus neutralizing antibodies, induces strong immunity and protects from parvovirus enteritis infection [3]; therewith at least 75% of dog population should be covered by the vaccination for maintaining favourable epidemic situation [6]. It should be noted, that compliance with all dog vaccination rules and schedule does not provide complete protection of dogs from parvovirus enteritis infection. According to various data level of such protection can be 3–13% that is accounted for development of insufficiently high antibody titres [17, 20], even in adult animals with good vaccination history [26]. Puppies younger than 6 week-old can be affected by parvovirus enteritis even if maternal antibody titres are sufficiently high [11]. Therefore, problem of effective parvovirus enteritis immunoprophylaxis remains unsolved.

The review is aimed at analysis and summarizing of data on specificity of postvaccinal anti-PCV immunity development in dogs.

MATERIALS AND METHODS

Searching for scientific publications on and practical guidelines for aspects and strategies of dog vaccination against parvovirus enteritis (in Russian and in English) was carried out. The publications were searched for using the following bibliographical and reference databases: Russian Science Citation Index (RSCI), Scopus, Web of Science, Agris, PubMed, as well as Google Scholar search system and the electronic library of theses of the Russian State Library (RSL). The said scientific publications were searched for regardless of date of their publication.

RESULTS AND DISCUSSION

According to the World Small Animal Veterinary Association (WSAVA) recommendations, multiple vaccinations should be performed and the last vaccination should be carried out at the age 16 weeks or later, then animals should be revaccinated at the age of 6 and 12 months. If, under certain circumstances, the vaccine can be administered only once the said vaccination shall be carried out at the age of 16 weeks or later. The WSAVA does not recommend administering basic vaccines more than once in three years after revaccination at the age of 6 or 12 months since the immunity may be long lasting and even lifelong [30]. D. I. Reutskaya (2003) recommends vaccination of puppies at the age of 6-weeks or older with subsequent 2 revaccinations at 3 and 2 week interval, respectively, that results in specific antibody titre increase by an average of 61.5% [5].

Vaccination of puppies having high maternal antibody levels at the age of 4 weeks induces early seroconversion that can result in narrowing of the "window of susceptibility" to canine parvovirus enteritis type 2; however, such vaccination becomes reasonable only in highly endemic areas [16].

K. D. Altman et al. (2017) observed strong negative correlation between time of the last vaccination and infection of puppies with parvovirus enteritis – the later the puppy was vaccinated the less the risk of vaccination failure [10] This supports the hypothesis that the use of final vaccination in puppies at less than 16 weeks of age predisposes to vaccination failure. Studies by R. D. Schultz et al. (2010) showed that dogs not subjected to revaccination against parvovirus enteritis for 9 years had serum antibody levels that were sufficiently high for conferring potential protection from the infection [9]. Even a single dose of vaccine, when administered at 16 weeks or older, could provide long-term immunity in a very high percentage of animals.

M. Taguchi et al. (2011) found that antibody titres remained sufficiently high only in 86% of dogs after their immunization against CPV-2; therewith the antibody titres were higher in young dogs and were not associated with sex of dogs [12]. Further studies showed that anti-CPV-2 antibody titres were significantly higher in dogs weighing less than 5 kg as compared with larger ones [19].

Most of dogs that have received regular basic immunization demonstrate sufficient antibody titres to parvovirus causing canine enteritis. However, D. Schoder et al. (2006) underlined the importance of an individual approach to CPV-2 immunoprophylaxis and noted that serologic testing for virus-specific antibody titre determination might offer an orientation about the immune status of the individual animal.

Anti-CPV-2 antibody titres are higher in 2-week-old puppies derived from female dogs additionally immunized 2–4 weeks prior mating as compared to that ones in puppies derived from non-vaccinated female dogs [2]. Puppies from female dogs vaccinated on day 42 of their pregnancy term receive high immunoglobulin concentrations with colostrum and are considered protected from parvovirus enteritis during the first 6–7 weeks of their life [13]. The difference between specific antibody titres in serum from 10 day-old puppies in one litter and from various litters is 25–87.5% and 94%, respectively. Specific maternal antibody titre in sera from 10-day-old puppies is 4.2–50% of the specific antibody titre in sera of their dams and further decreases by an average of 32% after their weaning and restored at the age of 6-weeks. There is a direct strong correlation between weight of newborn puppies and specific antibody titres in their sera. It is more evident in females than in males. Titre of antibodies to CPV-2 antigens decreases in female dogs by an average of 53.8% during lactation period [5].

There is no significant difference in specific antibody titre increase induced by administration of attenuated and inactivated anti-CPV-2 vaccine to dogs [21]. T. S. Galkina et al. (2006) found that vaccines produced by various manufacturers do not differ in their CPV-2 antigenicity, and virus-specific antibody production rate depends on presence of maternal antibodies rather than on vaccine type. Modern DNA-vaccines effectively induce both CPV-2 specific humoral antibody responses and cell-mediated immune responses and can be considered as reasonable alternative to conventional vaccines [22].

Some pharmacological therapeutics of immunomodulator group (roncoleukin and immunofanum) used as vaccine adjuvants contribute to maintenance of high antibody titres in young dogs during postvaccinal period [4]. *Propionibacterium avidum* KP-40 is a potent stimulator of macrophage-monocyte system and inducer of endogenous interferon. A. K. Siwicki et al. (1998), found that anti-CPV-2 vaccines adjuvanted with *Propionibacterium avidum* KP-40 induced significant enhancement of phagocytic and bactericidal activities of blood leukocytes accompanied by elevated serum levels of interferon-gamma and interleukine-1 levels and higher concanavalin A-induced blast-transformation rates of lymphocytes [7]. It was concluded that *Propionibacterium avidum* KP-40 could be applied as a potent and safe adjuvant in vaccination of dogs and additionally it provided enhancement of non-specific antibacterial and antiviral resistance of the organism.

According to G. E. Moore et al. (2005) administration of combined vaccine, including vaccine containing CPV2 antigens resulted in adverse reactions in only 3.83% of vaccinated dogs; therewith, the predisposing risk factors were the following: neutering, low body weight and the age of less than 9 months [8]. Cases of parvovirus enteritis occurred shortly after vaccination were associated with infection with field CPV-2 strains rather than reversion to virulence of modified live virus contained in vaccine [24].

Mutations in field CPV-2 isolates raised concerns about the ability of CPV-2-containing vaccines to protect from infection with newly identified CPV-2b и CPV-2c types. However, studies carried out by E. M. Siedek et al. (2011) demonstrated cross-protection in dogs, vaccinated with NL-35-D CPV-2 strain currently used for commercial vaccine production, from virulent CPV-2b и CPV-2c strains [28]. Nevertheless, phylogenetic studies indicated the importance of ongoing molecular typing of the virus as a tool for monitoring of widespread circulating CPV-2 strains and

assessment of efficacy of current vaccines. Adjustments on the vaccine types to be used may have to be evaluated again according to each epidemiological situation in order to achieve the dog's optimal immune protection against CPV [23].

CONCLUSION

The vaccination of puppies is the most effective when the vaccine is administered thrice and puppies are vaccinated for the first time at the age of 6 weeks or later and for the last time at the age 16 weeks or later. The vaccine against CPV 2 can be administered to 4-week-old animals as well as pregnant female animals. The majority of regularly vaccinated dogs develop sufficient anti-CPV2 antibody titres and their growth rates do not depend on animal sex and type of vaccine but they can vary depending on animal age, body weight and presence of maternal antibodies. Anti-CPV-2 maternal antibody titres in newborn puppies demonstrate broad individual invariance and close correlation to body weight, sex as well as presence of antibodies in their dams. Immunomodulators applied as vaccine adjuvants are proved useful for maintaining high anti-CPV-2 antibody titres during postvaccinal period as well as modern DNA vaccines are proved to be used a reasonable alternative for conventional vaccination. The probability of adverse reactions associated with the administration of the combined vaccine containing canine parvovirus enteritis virus antigens is 3.8%; the predisposing risk factors are the following: neutering, low body weight and the age of less than 9 months old. Contemporary vaccines based on CPV-2 strains completely protect from other virulent strains of canine parvovirus type 2. However, phylogenetic studies indicate the importance of ongoing molecular typing of the virus for monitoring of circulating CPV-2 strain spread and for assessment of current vaccine efficacy.

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Submitted on 19.10.18
Approved for publication on 26.11.18