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Faecal shedding of canine parvovirus after modified-live vaccination in healthy adult dogs

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ABSTRACT

Since little is known about the persistence and faecal shedding of canine parvovirus (CPV) in dogs after modified-live vaccination, diagnostic tests for CPV can be difficult to interpret in the post-vaccination period. The primary aim of this study was to determine the incidence, duration and extent of CPV vaccine virus shedding in adult dogs and to investigate related factors, including the presence of protective antibodies, increase in anti-CPV antibody titres and development of any gastrointestinal side-effects. A secondary objective was to assess prevalence of CPV field virus shedding in clinically healthy dogs due to subclinical infections. One hundred adult, healthy privately owned dogs were vaccinated with a commercial CPV-2 modified-live vaccine (MLV). Faeces were tested for the presence of CPV DNA on days 0 (prior to vaccination), 3, 7, 14, 21 and 28 by quantitative real-time PCR. Pre- and post-vaccination serum titres were determined by haemagglutination inhibition on days 0, 7 and 28.

Transient excretion of CPV DNA was detected in 2.0% of dogs before vaccination. About one quarter of dogs (23.0%) shed CPV DNA during the post-vaccination period, but field and vaccine virus differentiation by VP2 gene sequencing was only successful in few samples. Faecal CPV excretion occurred despite protective serum antibody titres. Post-vaccination CPV shedding was not related to adequate antibody response after vaccination or to the occurrence of gastrointestinal side-effects. Despite individual differences, CPV DNA was detectable for up to 28 days after vaccination, although the faecal CPV DNA load in these clinically healthy dogs was very low.

Introduction

Canine parvovirus (CPV) commonly causes severe gastrointestinal disease, especially in young dogs. Faecal shedding from affected dogs is the major source of infection (Decaro and Buonavoglia, 2012; Greene and Decaro, 2012). In order to prevent epidemics and to protect individual animals, CPV modified-live vaccines (MLV) are recommended core vaccines for all dogs (Day et al., 2010; Welborn et al., 2011; Ständige Impfkomission Veterinär, 2013).

The immune response to MLV is very similar to that induced by natural infection. CPV vaccine strains maintain their capability to replicate in lymphopoietic tissues and the intestinal mucosa, causing viraemia and a brief period of faecal shedding (Carmichael et al., 1981; Veir et al., 2009; Decaro et al., 2014). The amount of virus excreted is considered sufficient to immunise other susceptible in-contact dogs and cats (Carmichael et al., 1984). Depending on the excreted viral load, vaccination can also cause positive results in nucleic-acid amplification assays and faecal antigen tests (Day et al., 2010). Thus, vaccine virus shedding can lead to misdiagnosis of parvovirus infection in the post-vaccination period. This is a serious diagnostic dilemma, especially in puppies presented with acute gastroenteritis shortly after primary vaccination.

Usually, the attenuated pathogens in MLV are incapable of causing disease. The occurrence of diarrhoea soon after vaccination has led to speculation about reversion to virulence among veterinarians and dog owners. However, a study in dogs with parvovirus-like disease after CPV modified-live vaccination demonstrated that most cases were related to infection with CPV field strains or other pathogens (Decaro et al., 2007).

Little is known about the duration and extent of CPV vaccine virus shedding in the field. A recent study in 26 naïve puppies provided the first reported data on the amount of faecal virus shedding after CPV-2 and CVP-2b vaccination (Decaro et al., 2014). In populations in which CPV is endemic, many adult dogs are likely to have pre-existing antibodies due to prior exposure or vaccination, and details of post-vaccination CPV shedding in adult field dogs remain unreported.

The number of healthy dogs shedding field virus due to subclinical infections also remains unclear. Recently, a study in two rescue shelters found a high faecal parvovirus prevalence (overall

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Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Healthy	CPV vaccination or antibody preparation within the last 12 months
No relevant abnormalities in history and physical examination	Illness, anaesthesia, surgery, or systemic drug treatment (except deworming) within the last 4 weeks
Minimum age of 1 year	Lack of required history data (e.g., lack of current vaccination card)

CPV, canine parvovirus.

37%) in 124 cats, despite the lack of clinical disease (Clegg et al., 2012). However, none of the 122 canine samples from the same shelters was positive for CPV by PCR and thus, shedding of CPV field virus in healthy dogs was considered a rare event.

The objectives of this study performed in healthy adult dogs were to: (1) evaluate the prevalence of CPV field virus shedding; (2) assess the incidence, duration and extent of vaccine virus shedding; and (3) determine factors associated with vaccine virus shedding, including the development of gastrointestinal disease, the presence of CPV antibodies and the extent of rise in CPV antibody titre after vaccination.

Materials and methods

Dogs

This prospective clinical trial enrolled privately owned dogs that were routinely presented to veterinarians for CPV vaccination. The protocol was approved by the responsible veterinary authority (Reference number 55.2-1-54-2532.3-61-11) and fulfilled the general German guidelines for prospective studies with informed owner consent.

One hundred healthy dogs were included (Tables 1 and 2). Dogs belonged to a variety of different breeds (52/100) or were mixed-bred (48/100). Median age was 5.4 years (range, 1.2–13.8 years; 95% confidence interval [CI_{95}] 4.8–5.9 years) and median bodyweight was 23.3 kg (range, 3.1–71.2 kg; CI_{95} 20.9–25.7 kg). The majority of dogs had a history of prior CPV vaccination (98/100, CI_{95} 92.6–99.9) and the median time since the last vaccination was 1.4 years (range, 1.0–12.1 years; CI_{95} 1.0–1.7 years).

According to current guidelines, adequate CPV vaccination was defined as completed primary vaccination series, including MLV at a 3–4 week interval with the last vaccination at a minimum of 14–16 weeks of age, a booster vaccination 11–13 months later, and subsequent revaccinations at a minimum of 3-yearly (Day et al., 2010; Welborn et al., 2011; Ständige Impfkomission Veterinär, 2013).

Table 2
Factors associated with post-vaccination canine parvovirus (CPV) shedding (days 3–28 of study).

Variable	Category	Dogs tested (*n*)	Dogs with faecal CPV shedding (%)	Univariate analysis (Fisher's exact test)		
				Odds ratio (for faecal CPV shedding)	95% Confidence interval	*P*
Age	1–3 years	18	5 (27.8)	1.32	0.42–4.23	0.759
	>3–6 years	38	9 (23.7)	1.02	0.39–2.67	1.000
	>6–9 years	29	5 (17.2)	0.59	0.20–1.78	0.439
	>9 years	13	4 (30.8)	1.54	0.43–5.57	0.496
Bodyweight	≤10 kg	18	4 (22.2)	0.92	0.27–3.14	1.000
	>10–20 kg	23	6 (26.1)	1.20	0.41–3.55	0.781
	>20–30 kg	30	10 (33.3)	2.12	0.81–5.55	0.195
	>30 kg	27	3 (11.1)	0.32	0.09–1.13	0.109
Sex and neuter status	Female intact	28	6 (21.4)	0.85	0.29–2.45	1.000
	Female neutered	29	9 (31.0)	1.77	0.66–4.71	0.299
	Male intact	23	3 (13.0)	0.41	0.11–1.50	0.262
	Male neutered	18	5 (27.8)	1.32	0.42–4.23	0.759
Environment	Urban	58	12 (20.7)	0.69	0.27–1.77	0.474
	Rural	40	11 (27.5)	1.45	0.57–3.73	0.474
Lifestyle	Family dog	70	16 (22.9)	0.89	0.32–2.48	0.798
	Utility or sporting dog	14	4 (28.6)	1.37	0.38–4.87	0.734
	Breeding dog	8	1 (12.5)	0.44	0.05–3.64	0.676
	Farm dog	6	2 (33.3)	1.69	0.29–9.80	0.623
Housing conditions	Other dogs/cats in the household	61	13 (21.3)	0.73	0.28–1.90	0.624
	No other dogs/cats in the household	37	10 (27.0)	1.37	0.53–3.55	0.624
Daily contact with other dogs	≤2	21	5 (23.8)	1.02	0.33–3.20	1.000
	3–5	57	12 (21.1)	0.73	0.28–1.87	0.630
	>5	20	6 (30.0)	1.54	0.51–4.61	0.555
Time since last vaccination	1–2 years	62	12 (19.4)	0.67	0.25–1.79	0.447
	>2–4 years	25	7 (28.0)	1.58	0.55–4.53	0.408
	>4 years	9	2 (22.2)	1.02	0.19–5.38	1.000
Vaccination status	Fully vaccinated	18	4 (22.2)	0.92	0.27–3.14	1.000
	Not fully vaccinated	80	19 (23.8)	1.07	0.32–3.73	1.000
Last CPV modified live vaccination	Strain 154	38	10 (26.3)	1.53	0.57–4.06	0.453
	Strain-NL-35	26	4 (15.4)	0.57	0.17–1.87	0.417
	Strain 780916	19	4 (21.1)	0.94	0.27–3.23	1.000
	Strain CAG2	10	3 (30.0)	1.62	0.38–6.87	0.686
	Other strains	3	0 (0.0)	0.48	0.10–2.26	1.000
Initial CPV titre	≥80	84	20 (23.8)	1.15	0.29–4.55	1.000
	<80	14	3 (21.4)	0.87	0.22–3.46	1.000
Titre increase after vaccination	≥2 titre steps	17	3 (17.6)	0.65	0.17–2.51	0.755
	<2 titre steps	81	20 (24.7)	1.53	0.40–5.87	0.755
Side-effects after vaccination	Yes	36	8 (22.2)	0.90	0.34–2.39	1.000
	No	62	15 (24.2)	1.12	0.42–2.98	1.000
Gastrointestinal side-effects after vaccination	Yes	15	2 (13.3)	0.45	0.10–2.13	0.509
	No	83	21 (25.3)	2.20	0.47–10.32	0.509
Lethargy after vaccination	Yes	23	6 (26.1)	1.20	0.41–3.55	0.781
	No	75	17 (22.7)	0.83	0.28–2.45	0.781
Regional lymphadenopathy after vaccination	Yes	20	3 (15.0)	0.51	0.14–1.91	0.389
	No	78	20 (25.6)	1.95	0.52–7.30	0.389