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SHORT COMMUNICATIONS

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Decline in Maternal Immunity and Antibody Response to Vaccine in Captive Cheetah (*Acinonyx jubatus*) Cubs

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ABSTRACT: Blood was collected from captive cheetah cubs (*Acinonyx jubatus*) from the ages of 4 to 12 wk and monitored for the decline in maternally derived antibodies to feline panleukopenia, herpes and calici viruses. A steady decrease was seen in most of the cubs. Antibody responses to inactivated and/or modified live virus (MLV) vaccine also were measured. The strongest responses were seen post vaccination with MLV vaccine only.

Key words: *Acinonyx jubatus*, cheetah, cubs, maternal antibodies, vaccine response.

In felines, passive transfer of maternal antibodies from the immune queen to her offspring was first discussed by Enders and Hammon in 1940. At that stage, investigators believed this transfer occurred across the placenta, as in man. However, the newborn feline receives the majority of its maternally derived immunity via the colostrum (Tizard, 1987).

Studies on the transfer and decline of maternal immunity have been conducted on the domestic cat by numerous workers. Scott et al. (1970) showed that the half life for maternally derived feline panleukopenia virus (FPLV) antibodies varied among kittens, but was similar in kittens of the same litter. Johnson and Povey (1983) showed that the level of specific antibody in maternal serum is a major factor in determining the amount of antibody transferred to the kittens. They also were able to demonstrate maternally derived antibodies to feline calicivirus (FCV) persisting for up to 14 wk. No similar studies have been done on nondomestic species and data from domestic cats have been assumed to reflect the situation in other felids.

As the time of effective vaccination depends on the disappearance of maternally derived immunity (Johnson and Povey, 1983), it is of critical importance to know when this occurs so that the most effective vaccination program may be implemented. This communication deals with the decline of maternally derived antibodies to feline viruses and the response to vaccination in captive cheetah (*Acinonyx jubatus*) cubs. An enzyme-linked immunosorbent assay was developed in order to determine antibody levels.

Captive cheetahs were housed in fenced enclosures at the De Wildt Cheetah Breeding and Research Centre (National Zoological Gardens, Pretoria, South Africa). Each litter is housed separately with their mothers until weaning. Ten cubs were bled from the medial saphenous vein while being physically restrained every 2 wk from 4 to 12 wk of age. The mothers were bled at the same time. Three cubs were bled prior to vaccination, 1 mo post vaccination with inactivated FPLV vaccine and then 1 mo post vaccination with modified live multivalent vaccine. Ten cubs were bled prior to vaccination and again 1 mo post vaccination with modified live multivalent vaccine. The vaccines used were (1) Felocine (SmithKline Beecham Animal Health, Private Bag X56, Halfway House, 1685, South Africa) containing inactivated FPLV and (2) Felocell (SmithKline Beecham) containing modified live FPLV, fe-

TABLE 1. Decline in maternally derived antibodies to feline panleukopenia virus (FPLV), feline herpesvirus (FHV) and feline calicivirus (FCV) in captive cheetah cubs. Values given as mean ELISA titre per litter.

Litter	Virus	Maternal antibody levels	ELISA antibody titre age in weeks				
			4	6	8	10	12
F6	FPLV[a,b]	0.38	NT[c]	0.59	0.33	0.28	0.26
	FHV[a,b]	0.50	NT	0.59	0.41	0.28	0.30
	FCV[a,b]	0.95	NT	0.50	0.41	0.26	0.23
F3	FPLV	0.44	0.31	0.27	0.28	0.33	NT
	FHV	0.64	0.17	0.22	0.29	0.35	NT
	FCV	0.94	0.62	0.49	0.51	0.46	NT
F22	FPLV	0.42	0.29	0.28	0.28	0.39	NT
	FHV	0.79	0.28	0.27	0.26	0.38	NT
	FCV	0.77	0.53	0.43	0.32	0.29	NT

[a] Positive control value = 1.00 for all viruses.
[b] Negative control values = FPLV 0.27, FHV 0.33, FCV 0.27.
[c] NT = Not tested.

line herpesvirus (FHV) and FCV. The percentage transfer of maternal antibodies was calculated by dividing the mean titre of kittens in each litter by the titre of the mother and multiplying by 100 to obtain a percentage. Antibody levels were measured by means of an enzyme-linked immunosorbent assay (ELISA) (Spencer and Burroughs, 1991).

With reference to Table 1, it can be seen that litter F6 showed a continuous decrease in antibody level to all three viruses. Litter F3 showed stable antibody levels to FPLV, increasing levels to FHV and slightly decreased levels to FCV. Litter F22 showed stable levels to FPLV and FHV with an increase at 10 wk of age. However, the antibody levels to FCV showed a continuous decrease.

With reference to Table 2, it can be seen that the response to inactivated FPLV in litter F1 was very low and antibody levels decreased even further after administration of modified live vaccine. The remaining litters all showed increased antibody levels to the three viruses except for litter F3 whose antibody levels to FPLV remained stable.

The mean percentage of colostral antibodies passed to the cheetah cubs for each virus was consistent with that found in the literature. FPLV was 78% and this compares favourably with that of 72% found by Scott et al. (1970). FCV was 59% which is slightly less than that found by Johnson and Povey (1983). The mean percentage of colostral antibody transferred for FHV was 50% (Table 3).

Maternal serum immunoglobulins, mainly IgG, are concentrated in colostrum and readily absorbed by the intestinal epithelium during the first days of life (Schla-

TABLE 2. Mean antibody levels in response to vaccination in captive cheetah cubs as measured by ELISA.[a]

Litter	Virus	Pre-bleed	ELISA antibody titre: One month post Felocine	ELISA antibody titre: One month post Felocell
F1	FPLV	0.92	0.97	0.67
	FHV	0.17	NT	0.24
	FCV	0.19	NT	0.39
F6	FPLV	0.26	NT	0.52
	FHV	0.30	NT	0.49
	FCV	0.23	NT	0.71
F3	FPLV	0.33	NT	0.33
	FHV	0.35	NT	0.53
	FCV	0.46	NT	0.56
F22	FPLV	0.33	NT	0.40
	FHV	0.38	NT	0.56
	FCV	0.29	NT	0.50

[a] Abbreviations and subscripts as in Table 1.

TABLE 3. Maternal antibody levels and percentage antibody transfer from adult female cheetahs as measured by ELISA.*

Mother	Virus	ELISA antibody titre	% Maternal antibody transfer
F6	FPLV	0.38	87
n cubs = 4	FHV	0.50	82
	FCV	0.95	43
F3	FPLV	0.34	91
n cubs = 3	FHV	0.56	30
	FCV	0.94	66
F22	FPLV	0.52	56
n cubs = 3	FHV	0.72	39
	FCV	0.77	69

* Abbreviations and subscripts as in Table 1.

mowitz, 1976). Therefore, the level of specific antibody in maternal serum is a major factor in determining the amount of colostral antibodies passed to offspring. Unfortunately, the cubs could not be bled before 4 wk of age. Therefore, their neonatal antibody levels could not be determined. However, if the level at the first bleeding is considered, it can be assumed that initial levels were consistent with maternal levels.

The antibody levels in the cubs were seen to decrease steadily with time. In those litters where antibody levels remained stable (F3 and F22) or increased prior to vaccination (F3 and F22) one can assume that they must have been exposed to natural virus. There have been clinical cases of disease in unvaccinated animals in the past and feral cats were found on the property.

The antibody response to inactivated panleukopenia vaccine (litter F1) was negligible. The decrease in antibodies after administration of modified live vaccine may have been due to sequestration of existing antibodies (Macartney et al., 1988). The response in all the litters to MLV vaccine was good. Litter F6 showed the highest rate of seroconversion and this litter was vaccinated at 12 wk. Litter F1 was vaccinated at 16 wk and litters F3 and F22 at 10 wk. From this it would appear that 12 wk is the most favourable time for vaccinating cheetah cubs. The above study also has shown that modified live virus vaccines can be used with safety in captive cheetahs.

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