



Maternally derived antibody against canine parvovirus

part 2: degradation half-life and vaccine interference



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Objectives

- Confirm previously determined half life and degradation rate for maternally derived antibody against CPV-2
- Determine if MDA degradation is significantly different between individual puppies
- Evaluate interference with parvovirus immunization at varying MDA titers

Introduction

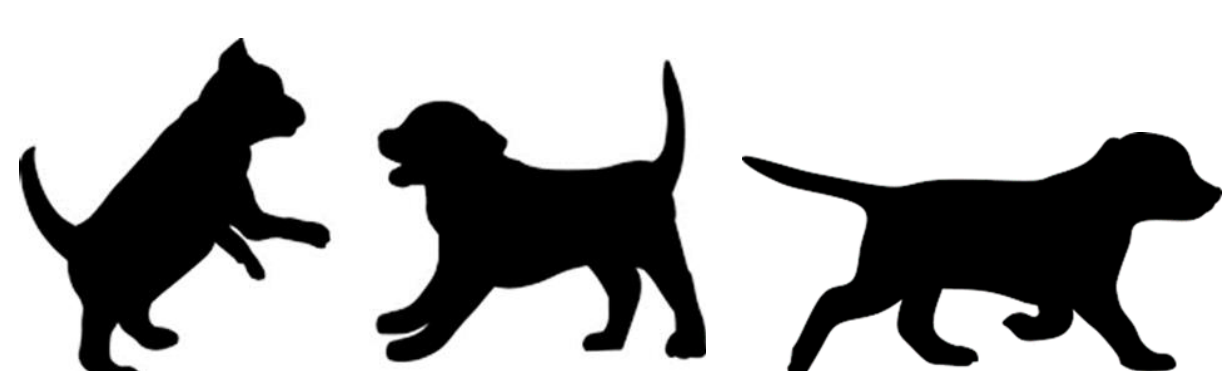
- After acquisition of maternally derived antibody (MDA) through colostrum consumption, the absorbed antibody begins to degrade
- MDA is known to be an important cause of vaccine failure in young animals^{2,3}
- Modified live viral (MLV) vaccines are neutralized by high circulating antibody titers
- Half-life degradation rate in pups has been found to average 8.4 to 13.4 days²
- Knowledge of MDA half-life allows accurate nomograph analysis to predict an effective vaccination schedule for pups³
- Understanding degradation variability between individuals allows the application of a nomograph generated vaccination schedule to an entire litter

Methods

- Serum samples were collected from 101 beagle pups at timepoints after birth (in days): 14, 28, 42, and 56
- Sera were tested for MDA against CPV-2 via hemagglutination inhibition (HI) assay¹
- A subset of 48 pups with CPV MDA titers equal to or above titer of 1:80 at Day 14 were used to calculate the half-life of MDA using the standard equation:

$$N(t) = N_0 \left(\frac{1}{2} \right)^{\frac{t}{t_{1/2}}}$$

- Titer values of the entire group of 101 pups were then converted to geometric mean values to determine variability in degradation rate between individuals
- An estimate of circulating antibody at birth was calculated based on published antibody half-life¹
- Geometric mean values were statistically analyzed with a repeated measures, one-way ANOVA test and Tukey's multiple comparisons *post hoc* correction (alpha= 0.05; 95% CI)
- Geometric mean titer values were averaged for each collection time point and graphically presented (Fig 2) to obtain the MDA degradation rate (slope of the line)
- All pups were vaccinated at Day 42 and evaluated for response by Day 56



Results

- Average half-life ($t_{1/2}$) of MDA against CPV-2 was 11.7 days (range 7-21 days)

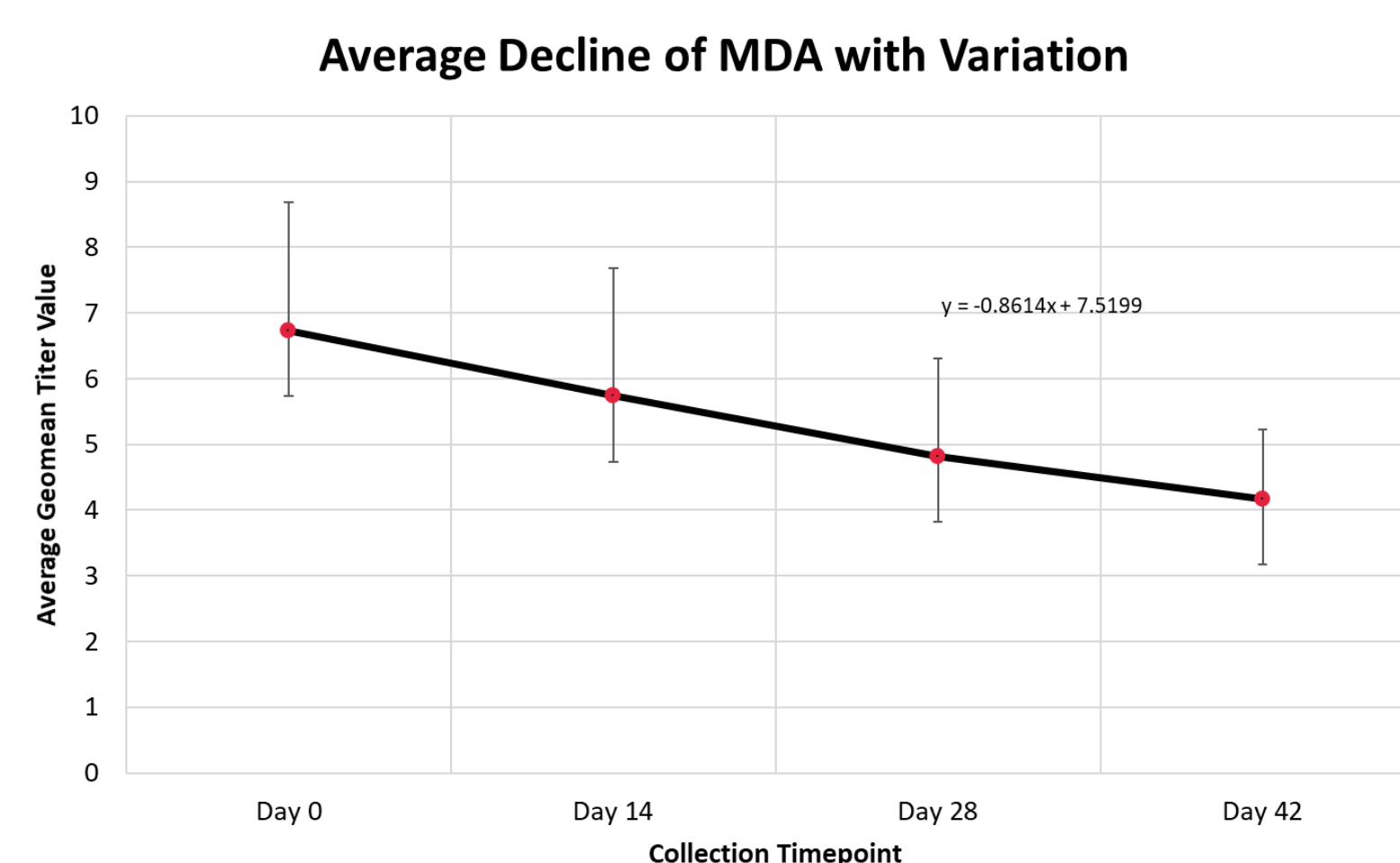


Fig. 1 – average geometric MDA titer with titer value range per timepoint

- Slope = 0.861 titer value/time (days)

Degradation and Response to Vaccination on Day 42

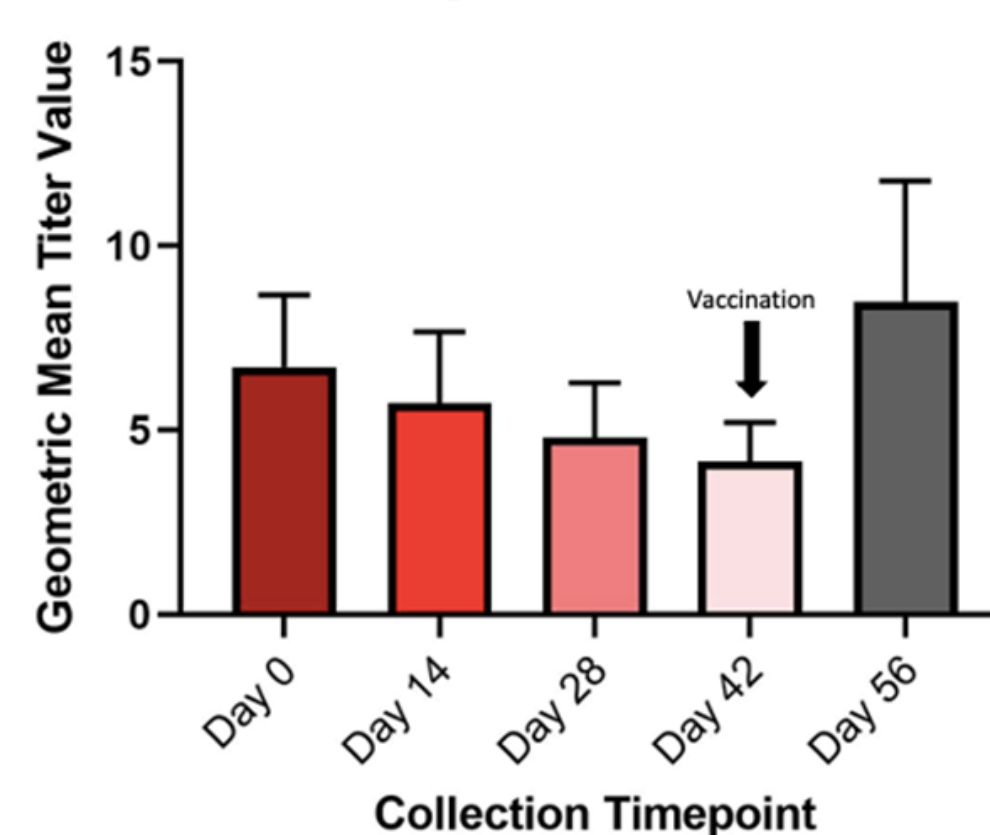


Fig. 2 – declining MDA titers and response to vaccination at Day 42

- Vaccination response rate at Day 42 was 73%

- No significant difference in degradation between 101 individual pups via ANOVA ($p = 0.531$)

Active response rate to vaccination on Day 42 according to various titer levels

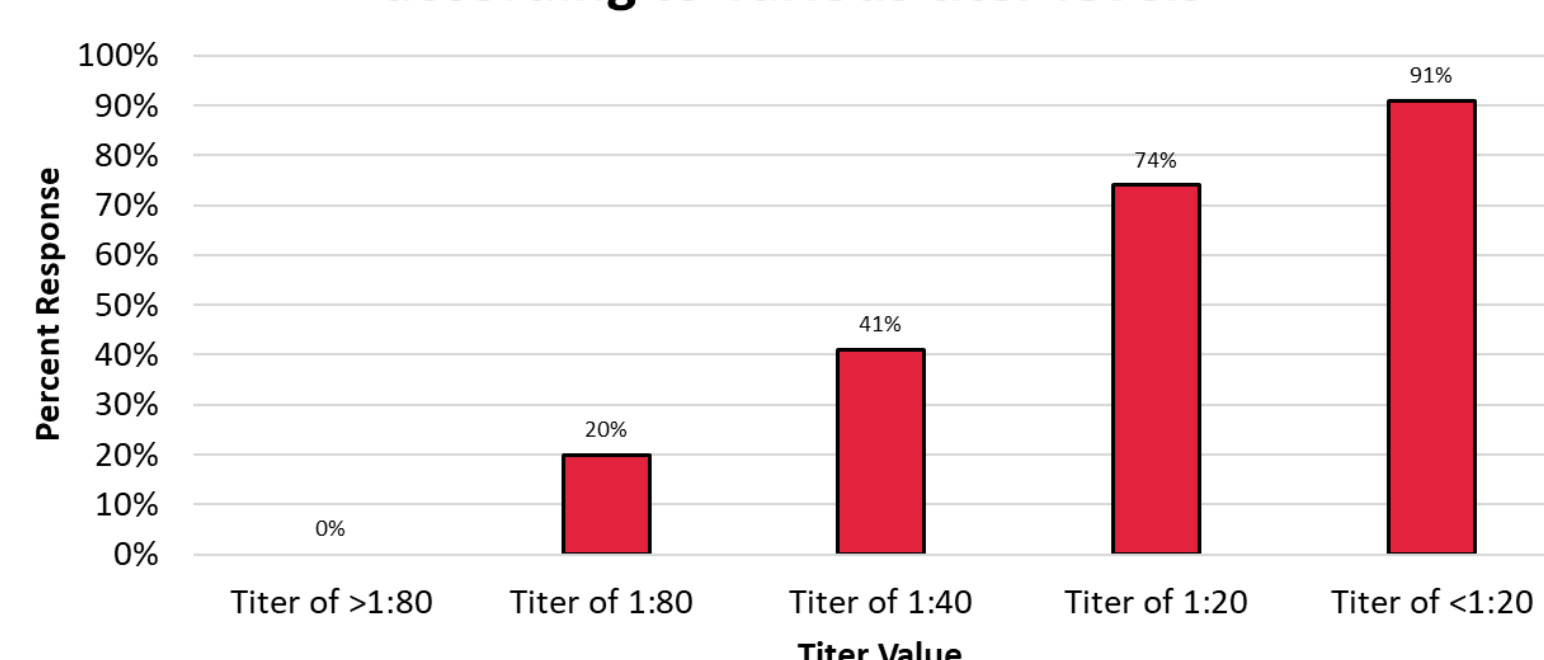


Fig. 3 - response to vaccination at Day 42 at varying MDA titer levels

- No pups responded to vaccine at MDA titers > 1:80

References

1. Carmichael LE, Joubert JC, Pollock RV: Hemagglutination by canine parvovirus: serologic studies and diagnostic applications. *American Journal of Veterinary Research*. 41(5): 784-91, 1980
2. Pollock, R. V. H., & Carmichael, L. E. (1982). Maternally Derived Immunity to Canine Parvovirus Infection: Transfer, Decline, and Interference with Vaccination. *Journal of the American Veterinary Medical Association*, 180(1), 37-42.
3. Larson, L., Thiel, B., Santana, V., & Schultz, R. (2020). Canine nomograph evaluation improves puppy immunization. *Clinical Theriogenology*, 12(3), 215-221.
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Conclusions

- Published half-life for canine MDA was previously found to average 10.9 days². This study found a slightly longer half-life at 11.7 days.
- No significant difference was seen between pups ($n = 101$) in MDA degradation ($p = 0.531$)
- Slope of the line of degradation was previously determined at -0.842 titer value/time (days)². This study found a similar slope of -0.861 titer value/time (days).
- Complete MDA vaccine blockage was seen at titers greater than 1:80
- For each dilution that MDA titers decreased, chance of successful immunization increased by approximately 20%

Discussion

- This study confirmed the current nomograph analysis method which uses a 12-day half-life to calculate MDA degradation
- Even though nomograph analysis is calibrated to be conservative and accounts for standard error, the finding of 2 pups out of 48 with a 21-day half-life underscores the need for follow-up testing of puppies after the vaccination series is completed
- Similar degradation rates among individual puppies supports the use of a tailored vaccination schedule for an entire litter
- This study confirms previous findings² that MDA titers between 1:40 and 1:20 allow a 50% chance of successful immunization against CPV-2
- The 91% CPV-2 vaccine response rate when MDA titers reach <1:20 is similar to the protective antibody titer rate that was found in vaccinated adult dogs in a major study from our laboratory⁴ (data not shown, $n=5,054$)

Acknowledgements

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This study is dedicated to the memory of
Dr. Leland "Skip" Carmichael

Disclosures

All authors are employed at the Companion Animal Vaccine and Immuno-Diagnostics Service (CAVIDS) Laboratory, which performs fee-for-service titer testing, nomograph analysis and puppy follow-up titers.

