

Parvovirus Type 2c An Emerging Pathogen in Dogs

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Properties of Canine Parvovirus

- Single-stranded DNA virus
- Nonenveloped virus
- Small size
- Highly mutagenic
- Multiplies in rapidly dividing cells such as intestinal crypts



Nonenveloped Viruses

- Highly resistant to disinfectants
- Resistant to pH, temperature, and lipid solvents
- Stable in organic materials



Samples

- Antemortem: Feces, rectal swab
- Postmortem: Small intestine and tongue
- Fresh samples (2-5 grams) of feces
- Shipment: FedEx, overnight on wet ice packs
- Turn around time: FAT:24 hours
- PCR: 48-72 hours
- PCR and sequencing: 7-10 days
- Total Cost at OADDL per sample for CPV-2c: \$100



Canine Parvovirus Diagnostics

- Animal-side assays are available
- Recently the tests were found to be less sensitive
- Many reasons for lack of CPV detection
- Lack of reactivity of CPV-2c in existing assays



Laboratory-Based CPV Tests

- Fluorescent antibody test (FAT) on tongue and intestine
- FAT cannot be done on feces
- Immunohistochemistry on intestine and tongue
- CPV PCR



Canine Parvovirus Genotyping

- PCR
- 800 bases of CPV genome
- Target is viral protein-2 (VP-2) gene
- Based on the amino acid coded at 426 position



Distribution of CPV-2c in USA

- Distributed in 14 states in USA
- Highest numbers of CPV-2c detected in Oklahoma kennels
- Many large dog breeding facilities involved



Global Distribution of CPV-2c

- North America
- South America
- Europe: widely distributed
- Asia
- Australia: CPV-2c free



CONCLUSIONS

- CPV-2c is a potential threat to unvaccinated dogs
- Testing is the only sure way to confirm CPV-2c on a premise
- Physical properties of CPV are similar to other canine parvoviruses
- CPV-2c is antigenically different on some critical epitopes



Parvovirus Type 2C : An Emerging Strain of an Old Disease

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PARVO 2C

Canine Parvovirus 2c

- What is canine parvovirus 2c?
- How did canine parvovirus 2c evolve?
- Epidemiology of CPV 2c
- Prevention vs. treatment
- Do current vaccines protect?
- Summary



PARVO 2c

What is Canine Parvovirus 2c?

- 2c Parvo is in our practices already
 - Looks like the “original parvo”
 - May affect dogs longer with more severe clinical signs
 - Partial immunity hides early signs
 - Mucoïd diarrhea early
 - Depression
 - Unexplained death in puppies



Parvo History

- 1978 new Parvo diagnosed – Parvo type 2
 - CPV replicated in canine lymphatics and intestinal epithelium with massive shedding of wild virus in the feces
 - Mortality high
 - Canines only affected (CPV 2 did not replicate in cats)
- Isolated FPV-like Parvo from wild carnivores
- 7 amino acid changes from FPV to CPV
- Host species shift and rapid adaptation



The Evolution of Canine Parvovirus

- 1978 – Parvovirus 2 isolated
- 1982 – Parvovirus 2a variant emerged
- 1984 – Parvovirus 2b diagnosed
- Parvovirus 2a and 2b: prefer canine host
 - Can replicate in both cat and dog



PARVO 2C

Wildlife Hosts for CPV



- Wide range of hosts
 - Mustelidae (weasel, ferret, mink and badger)
 - Canidae (dogs, fox and wolf)
 - Procyonidae (raccoons)
 - Felidae (cats, lions, tigers and cheetah)



PARVO 20

The Emergence of CPV 2c

- Recent change in capsid protein suggests CPV is still evolving
 - Glu-426 mutation → 2c Parvovirus
- 2000: CPV 2c isolated in Italy
 - Retrospective study evaluating tissue samples
 - 1996: 2c present in Germany
- CPV 2c can experimentally infect domestic cats
 - Vomiting common



Decaro N, Desario C, Addie DD, Martella V, Vieira MJ, Elia G, et al. Molecular epidemiology of canine parvovirus, Europe. *Emerg Infect Dis* [serial on the Internet]. 2007 Aug [date cited].

Epidemiology of Canine Parvovirus 2c

- European Study*:
 - New variant 2c widespread in some European countries (Italy, Portugal, and Germany)
 - 60% of CPV isolates in Italy are 2c
 - Rapid mutation between 1995 and 2005
- South America:
 - Recent vaccine failure in Uruguay
 - Severe symptoms
 - CPV 2c isolated



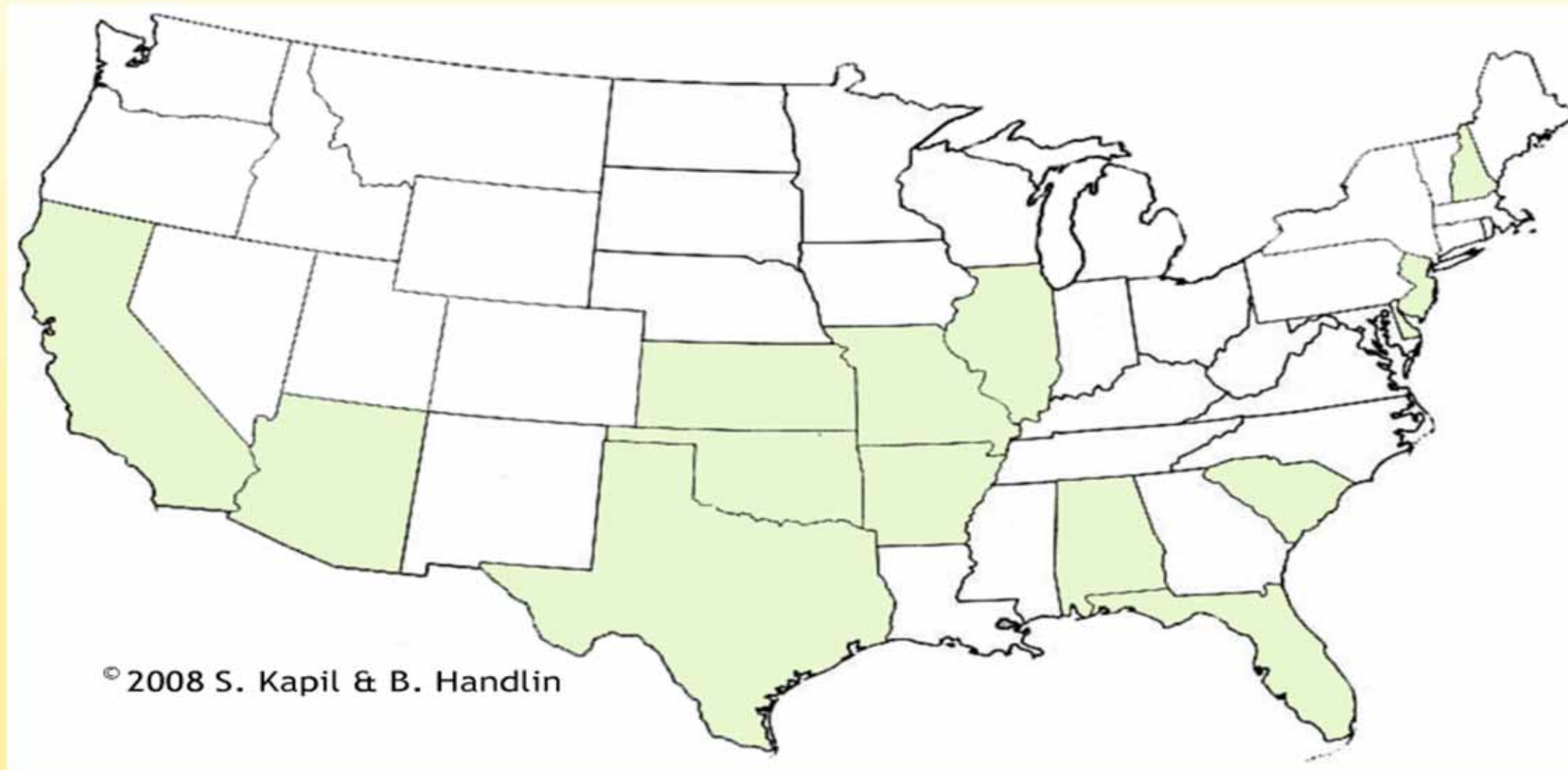
*Volume 13, Number 8–August 2007, CDC website, Molecular Epidemiology of Canine Parvovirus Europe

CPV 2c in the United States

- Early 2000:
 - Virulent Parvo Strain
- 2006: CPV 2c first isolated
 - Dr. Sanjay Kapil
 - Oklahoma Animal Disease Diagnostic Laboratory (OADDL)
 - Isolated over 60 cases in 14 states
 - Identified many variants of CPV 2c
 - Parvovirus is still evolving



Confirmed Distribution of CPV 2c within the US



PARVO 2c

Clinical Presentation of CPV 2c

- Severe depression
- Mucoïd or hemorrhagic diarrhea
- Leukopenia and lymphopenia
- Acute death in puppies



PARVO 2c

Testing

- Will parvovirus 2c be positive on a SNAP®?
- May be SNAP negative
 - Recheck in 2 days
 - No shedding early—vaccine titer slows shedding
 - IDEXX is evaluating test accuracy
- Confirmatory Test: PCR
- Low WBC count consistent with parvoviral infection
- If it looks and smells like parvo – it is parvo until proven to be something else!



2c Typing

- First identify parvovirus
 - Virus isolation from fecal sample or tissue
 - PCR sequencing to type (\$110)
- Post Mortem
 - Oklahoma State (OADDL)
 - Send 3 non-continuous sections of small intestine + section of tongue
- Typing Parvovirus:
 - OK State: 10-14 days
 - Cornell: can take several weeks



Treatment – It is Parvovirus

Aggressive therapy early

- IV Fluids
- Antibiotics
- Antiemetics
- Neupogen
- Pain Relief
- Early Feeding

Treat the environment

- Stable virus
- Bleach 1:30



PARVO 2C

Prevention: Veterinarian

- Stimulate active and solid immunity before exposure to wild parvovirus
- Parvovirus is everywhere
- Any vaccine titer can be overwhelmed with enough wild parvovirus
 - Avoid high exposure in dogs <1 year
- Sterilizing immunity is needed
 - Prevent shedding of wild virus



Challenge Testing: The Gold Standard

- Intervet's CPV Strain 154® Parvo vaccine (Nobi-Vac™ vaccine) challenge tested against CPV-2c
 - 12 SPF dogs: 6 vaccinates and 6 controls
 - Challenged with Italian 2c strain
 - Dogs were clinically monitored from 2 days prior to 14 days post challenge



Intervet UK, Abstract WSAVA 2006 Proceedings

Results

- Controls:
 - All became severely ill with 3 needing euthanasia
 - All had significantly decreased WBC from day 5 post challenge
 - All shed parvovirus in feces for at least 4 days post challenge
- Vaccinates:
 - All remained clinically normal throughout the study
 - No fecal viral shedding
 - Sterilizing immunity



US CPV 2c Challenge Testing

- Veterinary Therapeutics, Summer 2008:
“Do Two Current Canine Parvovirus Type 2 and Type 2b Vaccines Provide Protection Against the New Type 2c Variant?”
 - Intervet/Schering-Plough’s Continuum® vaccines (CPV Strain 154®) and Galaxy® vaccines (CPV 2b)
 - 28 SPF, seronegative dogs:
 - 18 vaccinates and 10 controls
 - Challenged with US CPV 2b and 2c isolates
 - Dogs clinically monitored from 2 days prior to 14 days post challenge



Results

- Controls:
 - All became severely ill with 5 needing euthanasia
 - All shed parvovirus in feces for at least 4 days post challenge
- Vaccinates:
 - All remained clinically normal throughout the study
 - No viral replication; no rise in titers with challenge
 - Sterilizing immunity



Conclusions

- Intervet/Schering-Plough's Continuum® and Galaxy® vaccines completely protected dogs from parvoviral disease following a CPV-2b and 2c challenge in SPF dogs



PARVO 2C

How can we protect our patients?

- Break through maternal antibodies
 - (Rottweiler study -- Hoskins)
- Sterilizing immunity a must
 - Intervet CPV Strain 154®
 - Begin parvo only vaccination early
- Keep puppies home until over 12-16 weeks
 - Dog parks avoided
- Vaccinate out to 16 weeks for parvovirus



PARVO 2C

PERFORMANCE OF PROGARD® VACCINES IN ROTTWEILER PUPPIES

By: Dr. Johnny D. Hoskins
Louisiana State University
Canine Practice, 1997

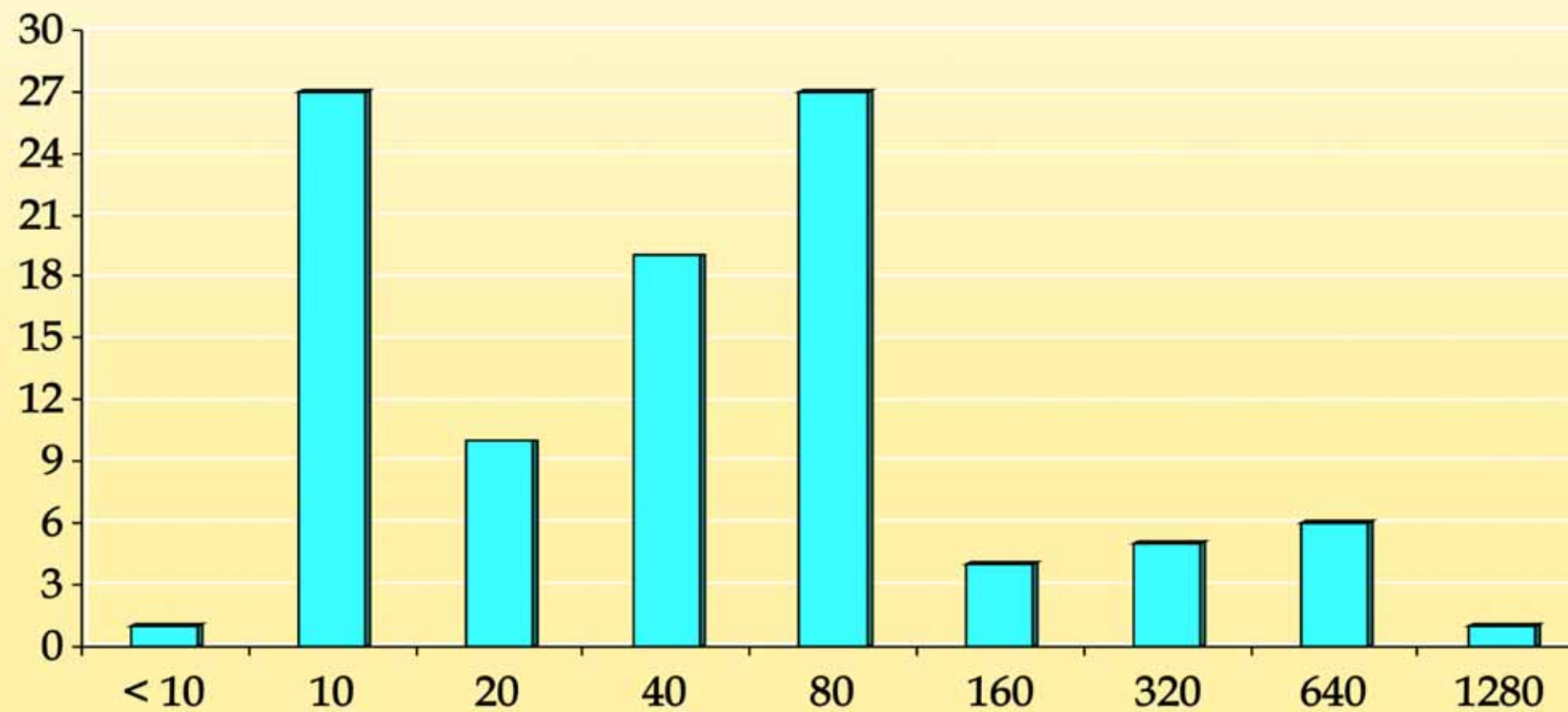


PARVO 2C

Maternally Derived Antibody Titers in 4 Week Old Puppies

of Puppies

(N=100)



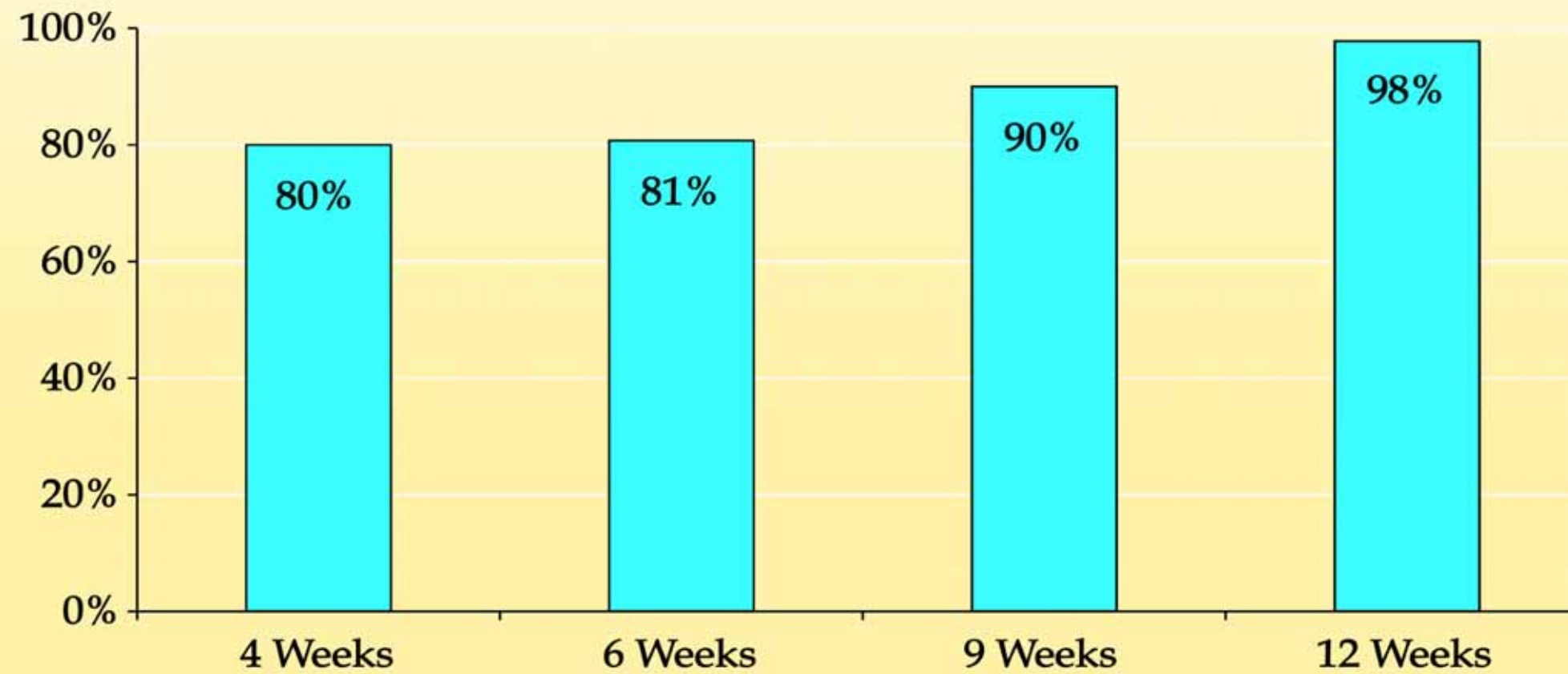
CPV HI titers



PARVO 2C

CPV Response In Rottweilers to CPV Strain 154® Vaccines

% Response

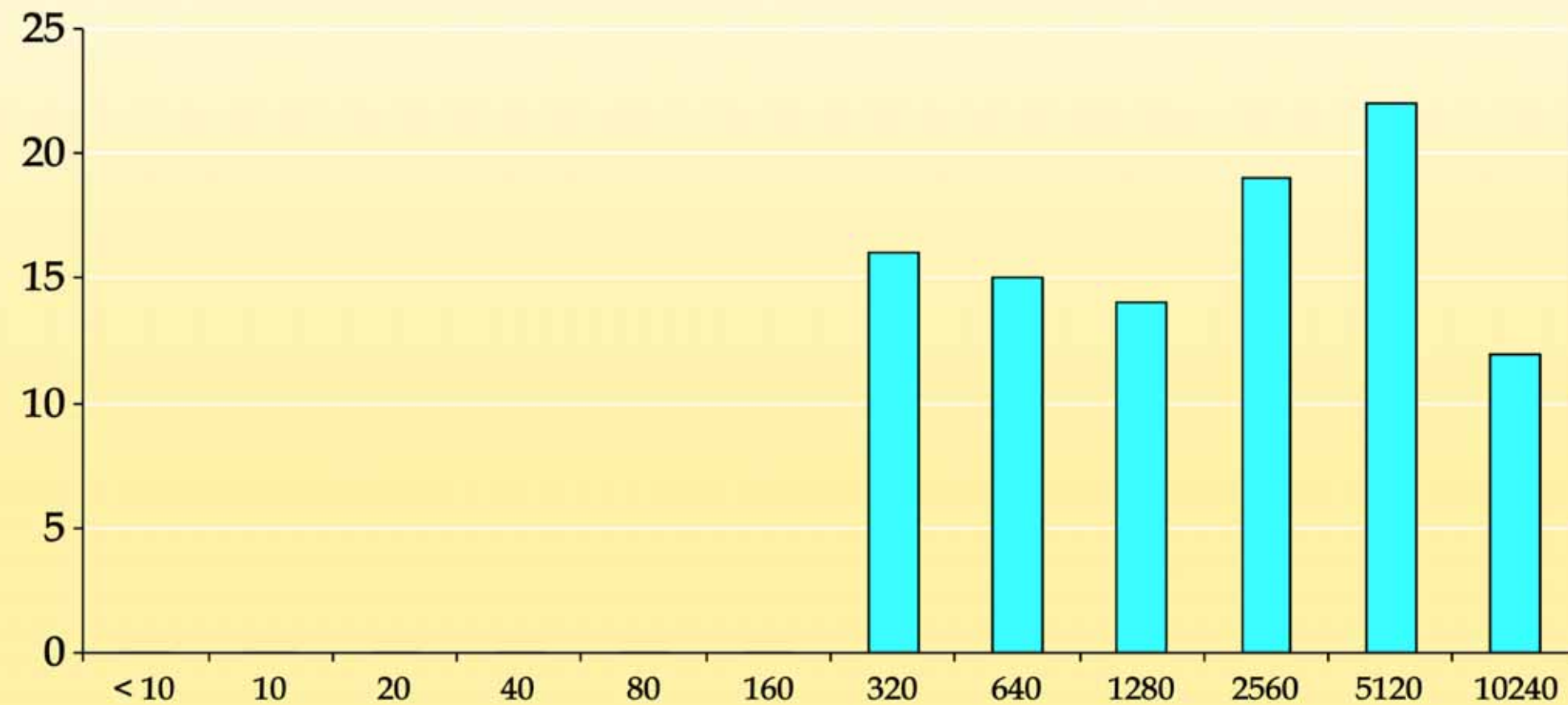


PARVO 2C

Rottweiler Response Titers

of Puppies

(N=98)



CPV HI titers



How can we protect our patients?

- Break through maternal antibodies
 - (Rottweilers study -- Hoskins)
- Sterilizing immunity a must
 - Intervet CPV Strain 154®
- Keep puppies home until over 12 -16 weeks
- Vaccinate out to 16 weeks for parvo



Results – CPV 3 year Challenge

Treatment Group	Dogs	9 CFR Requirements			Death
		Temp $\geq 103.4^{\circ}\text{F}$	Virus Shedding $\geq 1:64$	Lymphopenia $\geq 50\%$	
Continuum [®] DAP (CPV Strain 154 [®])	22	2	0	0	0
Control	6	1	6	6	2



PARVO 2C

How can we protect our patients?

- Break through maternal antibodies
 - (Rottweilers study -- Hoskins)
- Sterilizing immunity a must
 - Intervet CPV Strain 154®
- Keep puppies home until over 12 -16 weeks
- Vaccinate out to 16 weeks for parvo



PARVO 2C

Puppy Vaccination Protocols

- Vaccine labels vs. recommendations:
 - When to start vaccinating puppies
 - Interval between vaccines
 - When to complete puppy series
- Goals:
 - Stimulate active solid immunity before exposure to wild parvovirus
 - Start early as maternal antibodies wane
 - Maximize immunity and safety with vaccination interval
 - Override maternal antibodies by the end of the puppy series



Puppy Vaccination Protocol

Vaccine Guideline				
5 wks	7 wks	9 wks	12 wks	16 wks
Parvo	Parvo	DAP	DAP	Parvo

Vaccinate for parvo when puppy starts on solid food



PARVO 2C

Putting Knowledge into Practice: Dr. "R" from Arkansas

- Has worked with several breeding kennels
- Lost 900+ dogs to parvovirus over 13 months
- All affected puppies had received at least 1 vaccination
 - Many puppies had received 2-3 vaccinations
- Clinical Signs:
 - Mucoid diarrhea, bloody diarrhea, acute death
- PCR results from OADDL:
 - Canine Parvovirus **Type 2c** isolated from 3 different kennels



Dr. "R" from Arkansas

- Objective:
 - Decrease the amount of wild virus present every week
 - Resolve the parvovirus 2c outbreak in 90 days
- Plan:
 - Resolution involves 50% environmental management and 50% vaccination
 - Vaccinate as soon as puppies are eating food:
 - Parvovirus every 2 weeks until 9 weeks of age
 - DAP combo every 3-4 weeks from 9-12 weeks of age
 - Parvovirus vaccination again at 16 weeks of age
 - Use Intervet's vaccine line with CPV 154



Dr. "R" from Arkansas

- Results:
 - In first month lost 8 dogs (compared to losing an average of 70 dogs per month)
 - In the next 60 days lost 1 dog
- With adequate management and vaccination, could control CPV 2c in several kennels
 - Kept wild virus numbers low and immunity high to prevent wild parvovirus break



Conclusions

- Canine parvovirus continues to evolve
 - Design vaccination protocol around Parvo protection
- CPV-2c diagnosed in many states within the US
- CPV-2c reported in vaccinated dogs
- Evidence that 2 current vaccines are protective against CPV 2c challenge:
 - Continuum® vaccines (CPV Strain 154)
 - Galaxy® vaccines (CPV 2b)



Questions?



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