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Canine Distemper

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Canine Distemper

Highly contagious, virulent, and inoculable viral disease of dogs and other carnivores.

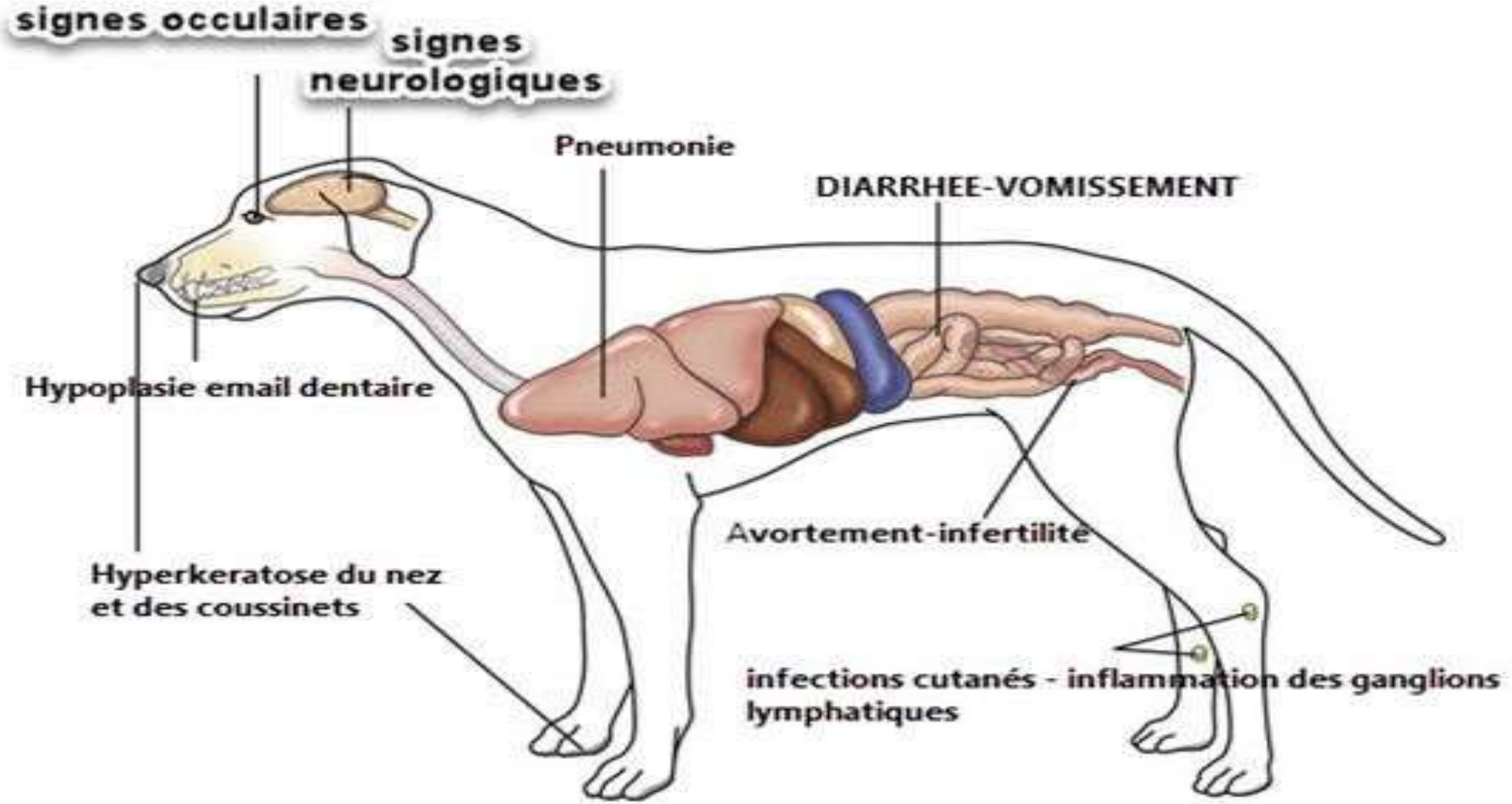
Infection caused by a pantropic Morbillivirus:

"Canine Distemper Virus" (CDV)

Severe immunosuppression eventually resulting in a **multisystemic disease that is often fatal.**

Affects: Respiratory, gastrointestinal, neurological, lymphatic, cutaneous, and ocular

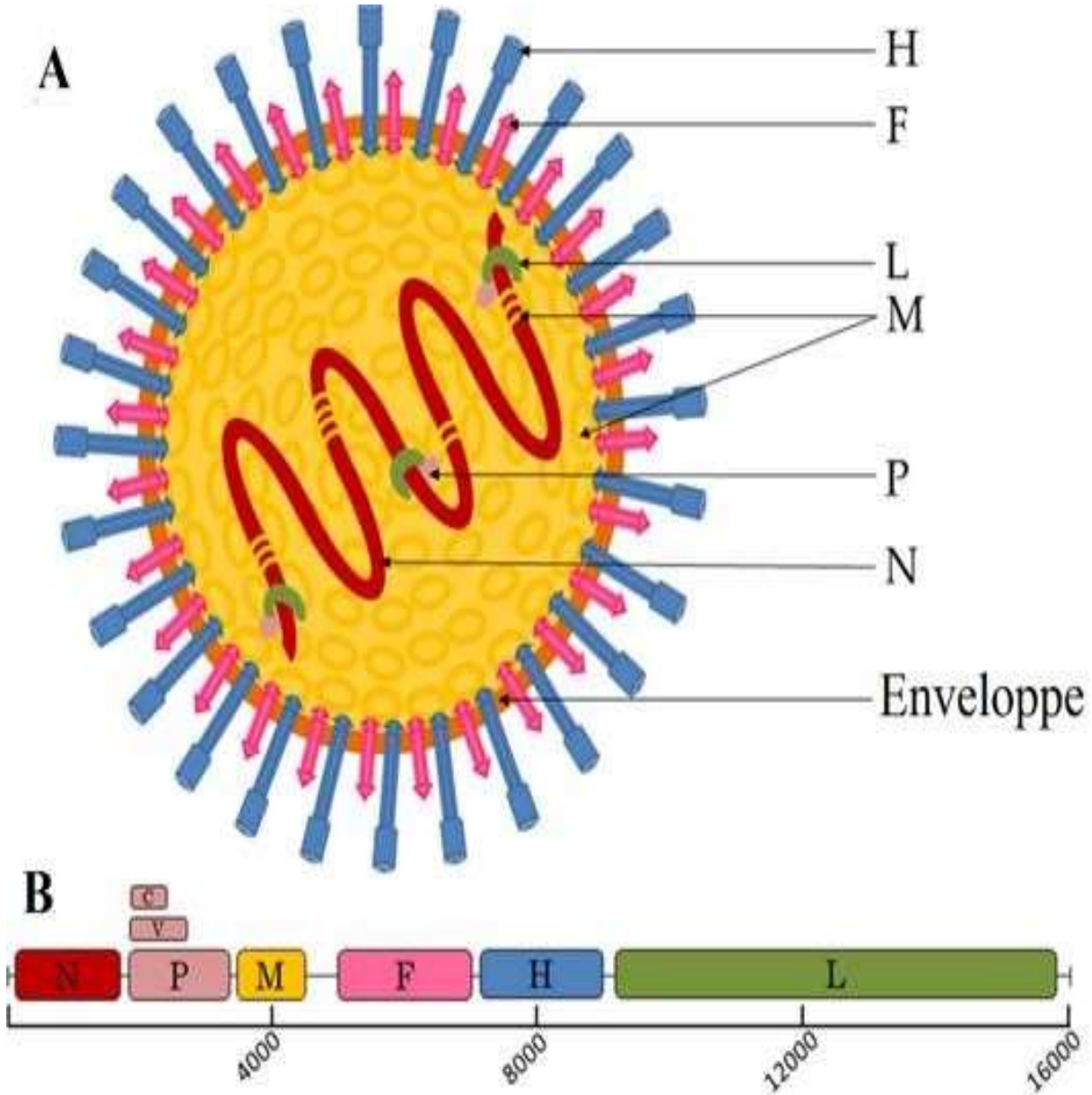
Anatomical sites targeted by CDV infection



Aetiology

- CDV belongs to the Morbillivirus genus, family Paramyxoviridae.
- Relatively large virus (variable diameter = 150 to 250 nm).
- **Enveloped.**
- Single-stranded RNA enclosed in a helical symmetrical nucleocapsid.
- CDV related to the viruses of measles and bovine plague differentiate by tropism and pathogenicity not from an antigenic viewpoint.

Structure of CDV. N: Nucleocapsid, P: Phosphoprotein, M: Matrix protein, F: Fusion protein, H: Haemagglutinin, L: Large polymerase protein.



The lipoprotein envelope derived from the cell membrane incorporating viral glycoproteins:

- H (attachment protein).
- F (fusion protein).

Proteins H and F regulate the entry of the virus into the host cell.

Epidemiology

- **Distribution** → Canine Distemper known worldwide
- **Incidence**

  * Fatal disease of dogs → Mortality rate ≈ 50%.

* High risk Young dogs aged between 2 and 6 months (loss of maternal-derived antibodies 'AOM' after weaning).

  * Risk of epizootic Community.

* Can affect dogs of any age (rare in properly vaccinated adult dogs).

- **Virus sensitive to the environment Enveloped virus = Inactivated by** →

  the environment (ambient temperature), heat, ultraviolet, the desiccation and usual disinfectants.

- CDV withstands low temperatures.

- **Host sensitivity The domestic dog**

(Canis lupus familiaris) is the species most sensitive to CDV; however, many wild carnivores can be infected.

Le nombre d'espèces de mammifères sensibles au virus de la maladie de Carré est très élevé.

Ordre	Famille	Espèce sensible
Carnivores	Canidés	Toutes les espèces
	Mustélidés	Toutes les espèces, y compris la loutre de rivière
	Procyonidés	Raton laveur, kinkajou
	Ursidés	Ours
	Ailuridés	Petit panda
	Méphitidés	Mouffette
	Félidés	Lions, tigres (chat : infection asymptomatique)
	Viverridés	Civette palmée
	Hyaenidés	Hyène
Artiodactyles	Tayassuidés	Pécari à collier

➢ Viral excretion

* Infected animals (clinical or subclinical) excrete CDV from 7 days post-infection (PI).

*** Viral excretion usually ceases 1 to 2 weeks after recovery; it may last 60 to 90 days PI (rare).**

* CDV ➡ Abundant in respiratory exudates (cough droplets).

*Infected animals excrete the virus in all bodily secretions and excretions (saliva, urine, and faeces, etc.) and the virus can be isolated in most tissues.

➢ Transmission

* Sensitive virus in the environment ➡ Direct contact with infected dogs (dog-to-dog).

* Oronasal route (aerosols and respiratory droplets).

*Viral transmission can occur through contact with all bodily secretions and excretions.

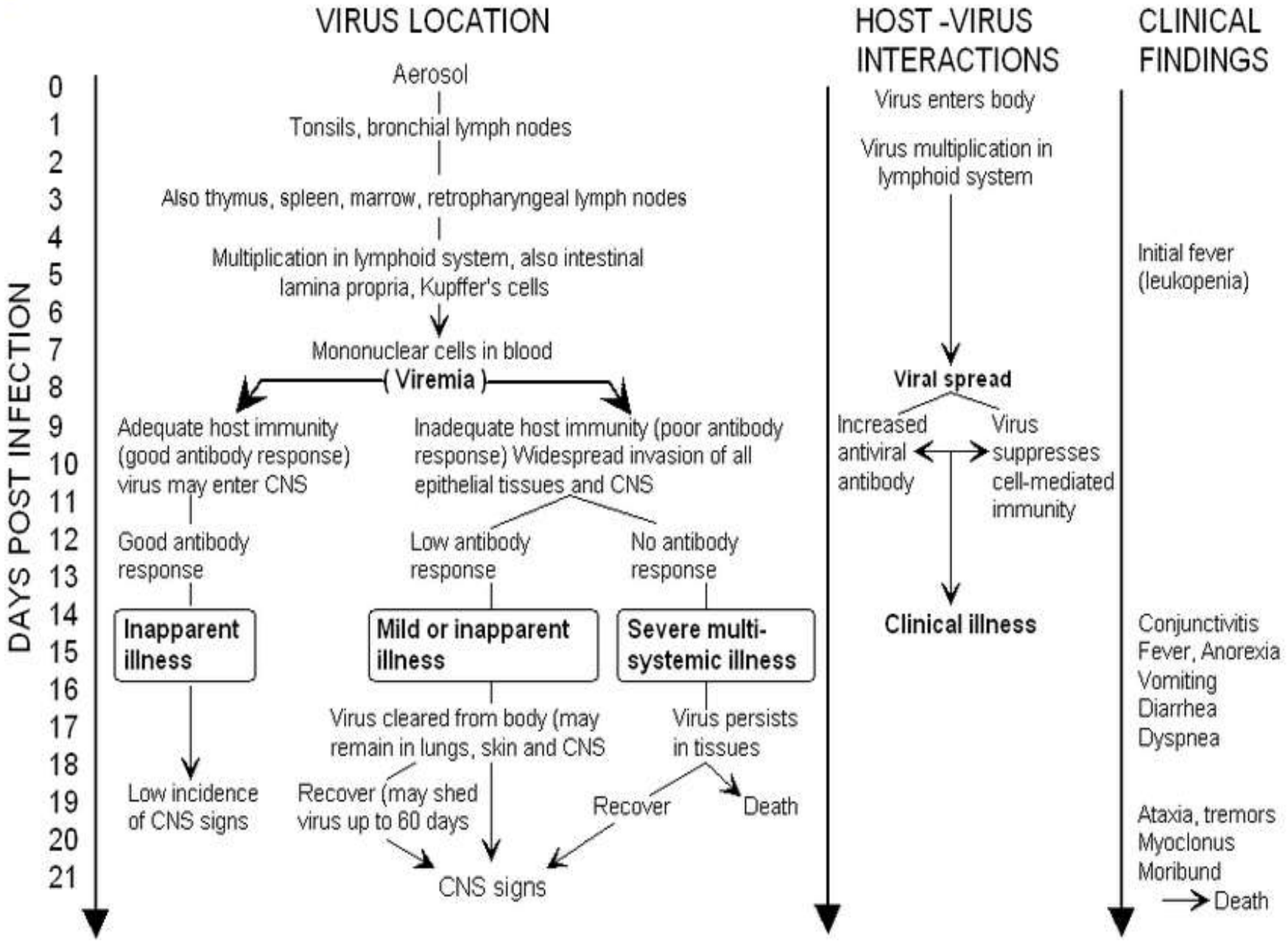
*Inanimate objects/surfaces ➡ Indirect transmission of the virus (water bowls, grooming tools, etc.).

* Transplacental transmission can occur from viremic mothers = Rare.

Pathogenicity

- CDV is an enveloped RNA morbillivirus of the family Paramyxoviridae.
- It is transmitted through contact with secretions from infected dogs (e.g. saliva, aerosols from cough, urine and feces) either through direct contact, or via objects/surfaces contaminated with these (e.g. water bowls or grooming
- tools).
- During the incubation period (3–6 days post-infection [PI]), direct viral destruction of
- Lymphocytes results in lymphopenia and transient
- fever.
- Further spread to cells in the respiratory tract, gut, CNS, skin and urinary tract may occur (days 8–9 PI), depending on immune status and immune response.
- This viral dissemination is usually accompanied by a second stage of cell-associated viremia and fever.
- Viral shedding from either clinically or subclinically infected dogs may start as early as 5 days after infection and continue for months.

Pathogenesis of CD and associated clinical signs (modified from Green and Appel)



Depending on adequate antibody titers and cell mediated immunity, one of three outcomes may occur:

- infection may be eliminated,
- classic acute distemper may occur, with subsequent death or recovery,
- or (3) there may be clinical resolution with viral persistence in the eye, lymphoid organs, footpads and CNS, creating the potential for late-onset sequelae, particularly ocular and neurologic disease.

Clinical study

- Clinical signs vary and depend on:

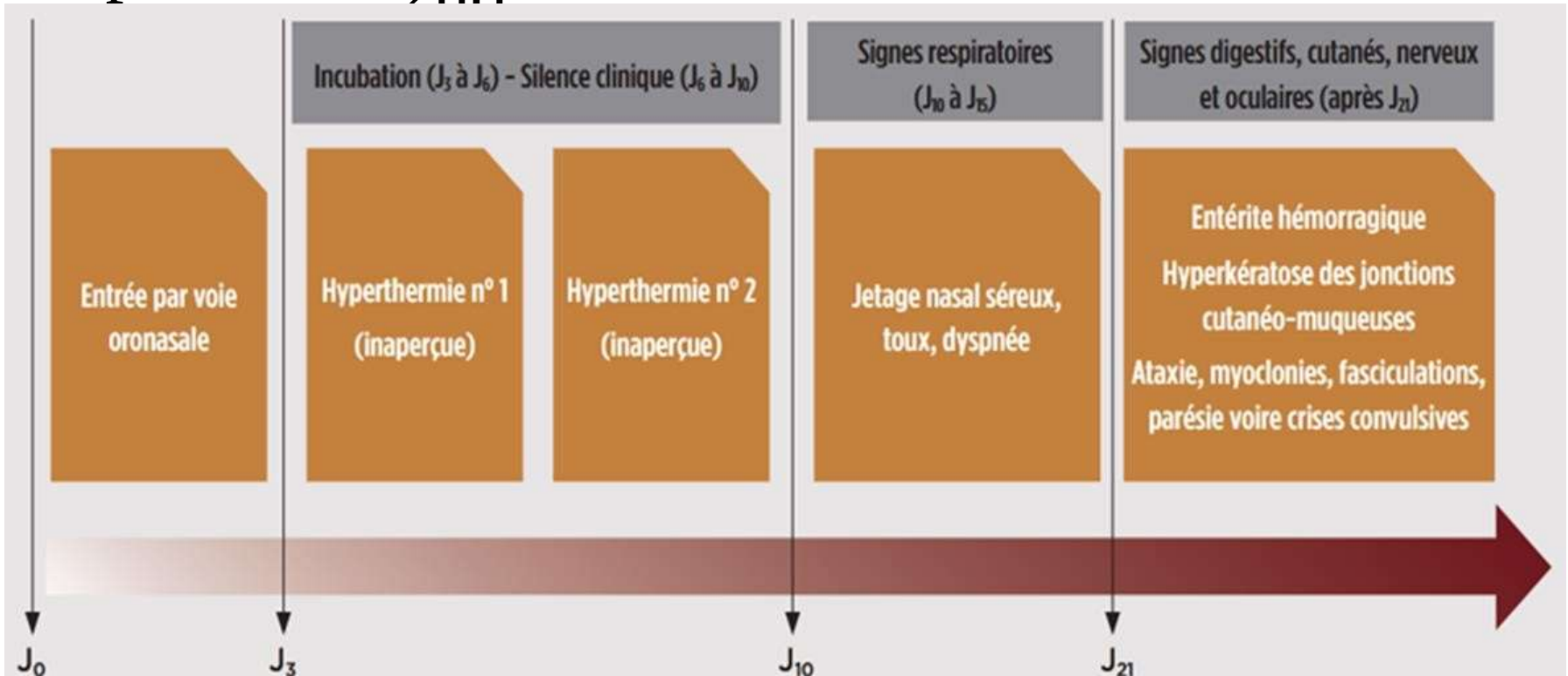
- ❑ The strain and viral load.
- ❑ The age and immune status of the host.
- ❑ Concurrent infections by other viruses and bacteria.

- > 50% of cases → Subclinical infection.
- Mild to moderate forms: Fever, lethargy, decreased appetite or anorexia, mild upper respiratory tract involvement (kennel cough).

Forme classique = Atteinte multisystémique progressive

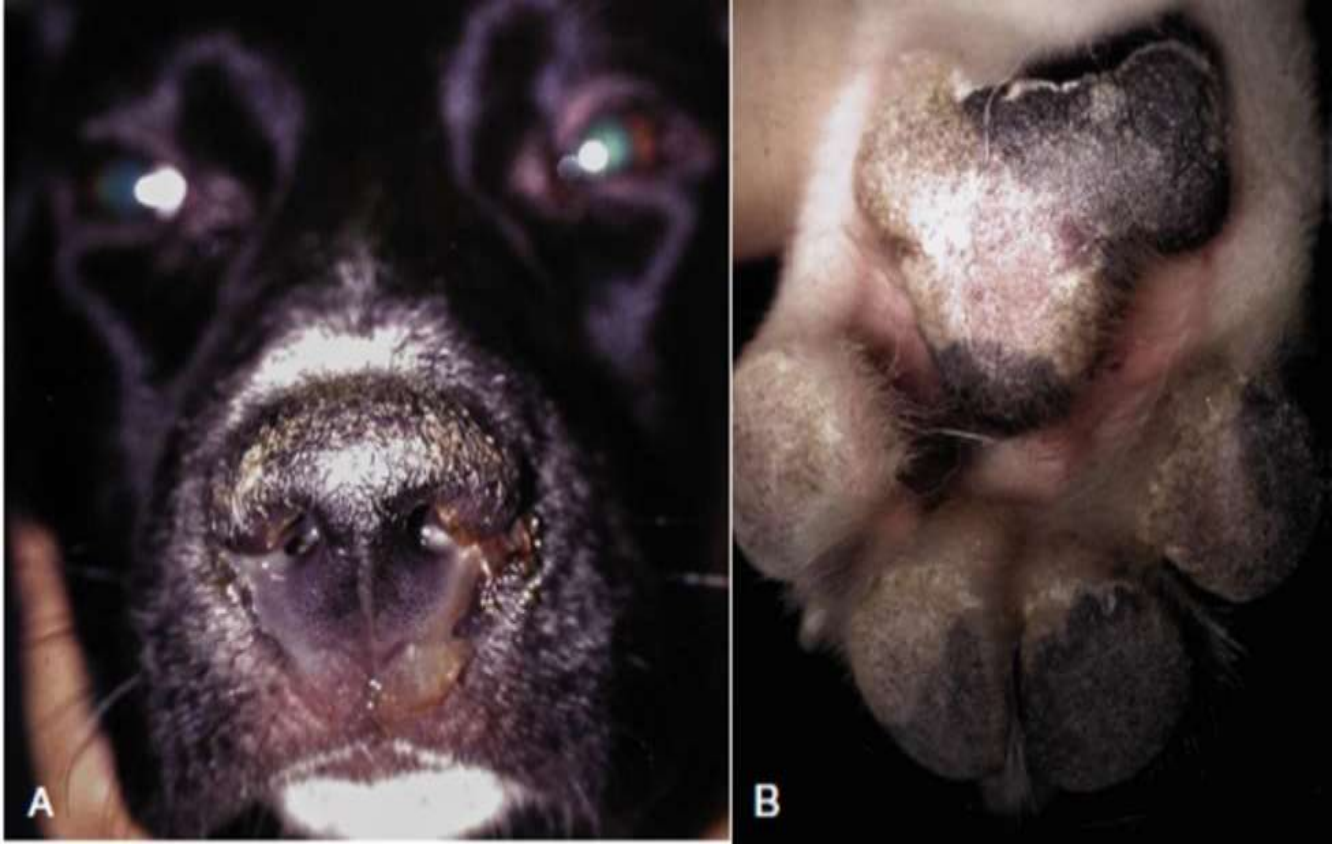
- Multisystem involvement = Fatal: acute, subacute or chronic.
- Incubation period = 3 to 6 days PI.
- **Systemic signs: Severe depression, anorexia and dehydration, biphasic fever (39.7 to 41 °C); Clinical signs coincide** generally with a fever peak. 2nd

Symptomatology of canine distemper disease.



➢ Respiratory signs:

- ❑ Rhinitis and conjunctivitis → Serous naso-ocular discharge → Mucopurulent to purulent (Bacterial superinfection).
- ❑ Persistent non-productive cough (dry cough) Moist.
- ❑ Bronchopneumonia → Productive cough, tachypnoea, dyspnoea, auscultation abnormalities.



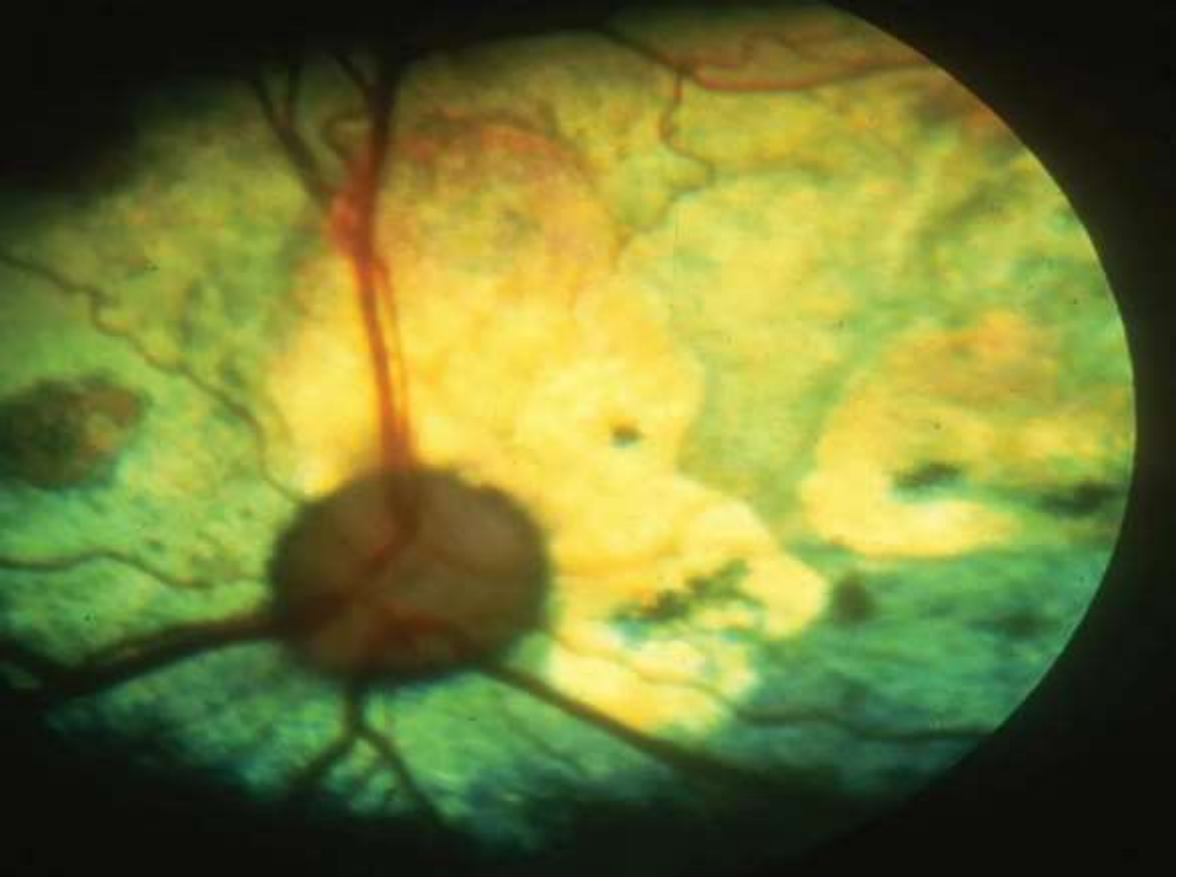
Hyperkeratosis of the nose (A) and of the paw pad (B) induced by a CDV infection in a Border 4-month-old Collie: Conjunctivitis, blepharospasm, nasal and ocular mucopurulent discharge, myoclonus.

Conjunctivitis in a dog with Canine Distemper

- **Digestive signs: Catarrhal enteritis → Anorexia, weight loss, vomiting, diarrhoea (sometimes haemorrhagic), tenesmus, dehydration, electrolyte imbalances.**

- **Ocular signs:**

  - Conjunctivitis, anterior uveitis, acute blindness (optic neuritis), dry keratoconjunctivitis.
  - Chorioretinitis → Fundic lesions "gold pieces" (hyperreflectivity due to retinal atrophy).



Chorioretinal scar in a dog that has recovered from a infection by the virus of the distemper= "gold medallion" lesions.

Optic neuritis associated with distemper: Optic disc hyperaemic with blurred and indistinct margins. Retinal vessels appear to be raised on the prominent disc.

➢ Nervous signs

≈ 30% of infected dogs CNS signs:

- ❑ Simultaneously with multisystemic signs or
- ❑ Delayed from 1 to 6 weeks after the onset of acute disease or
- ❑ Months after apparent recovery from a systemic disease.
- ❑ Sometimes, after a pure subclinical infection. → neurological distemper

2 types of CNS involvement:

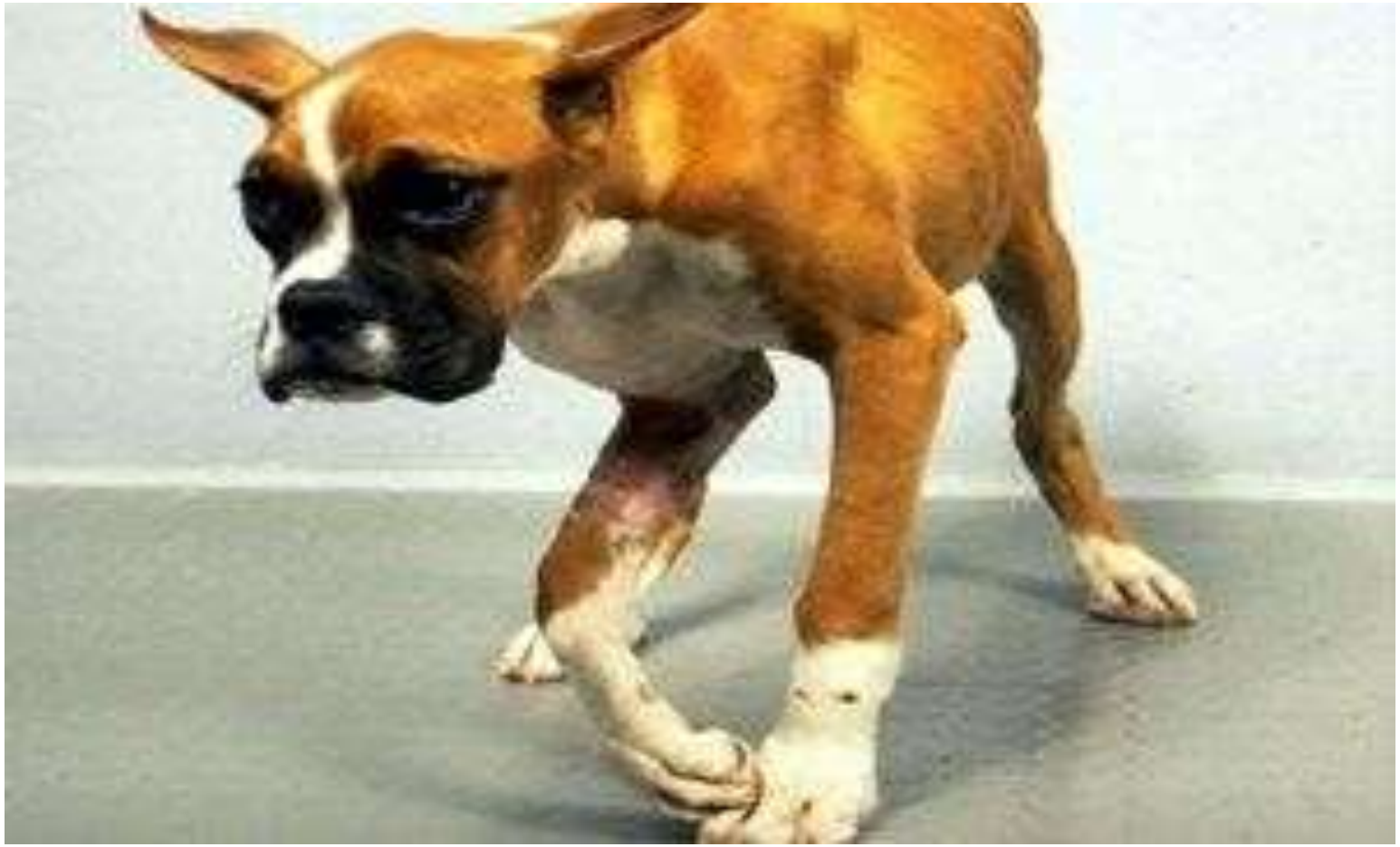
- ❑ Acute encephalomyelitis: Grey matter lesions (cell bodies).
- ❑ Subacute or chronic non-suppurative encephalomyelitis White matter (demyelination of myelinated axons).

Diffuse or multifocal involvement of the CNS is typical:

- Acute encephalitis: Generalised seizures, focal epileptic seizures localised to the head and jaw (chewing gum seizures) + hypersalivation, circling gait, behaviour change.
- Mesencephalon (midbrain), cerebellum, vestibular system: Disturbance of wakefulness (alertness), cerebellar ataxia, vestibular ataxia.
- Spinal cord: Meningeal signs of hyperesthesia, neck stiffness, gait disturbances, paresis (paraparesis, tetraparesis), abolished or diminished spinal reflexes, proprioceptive deficit.
- Myoclonus (Cortical, thalamocortical, brainstem, or spinal): Involuntary rhythmic contractions of specific muscle groups.

Myoclonus = The most common neurological sign.

- Cranial and spinal nerves = Peripheral neuropathies = Deficits of the cranial nerves (Example: Optic neuritis).
- Neurological signs rarely disappear Generally progressive Myoclonus may persist in dogs that appear to have recovered.



Severe nervous disorders (ataxia) in a dog with an advanced form of distemper.

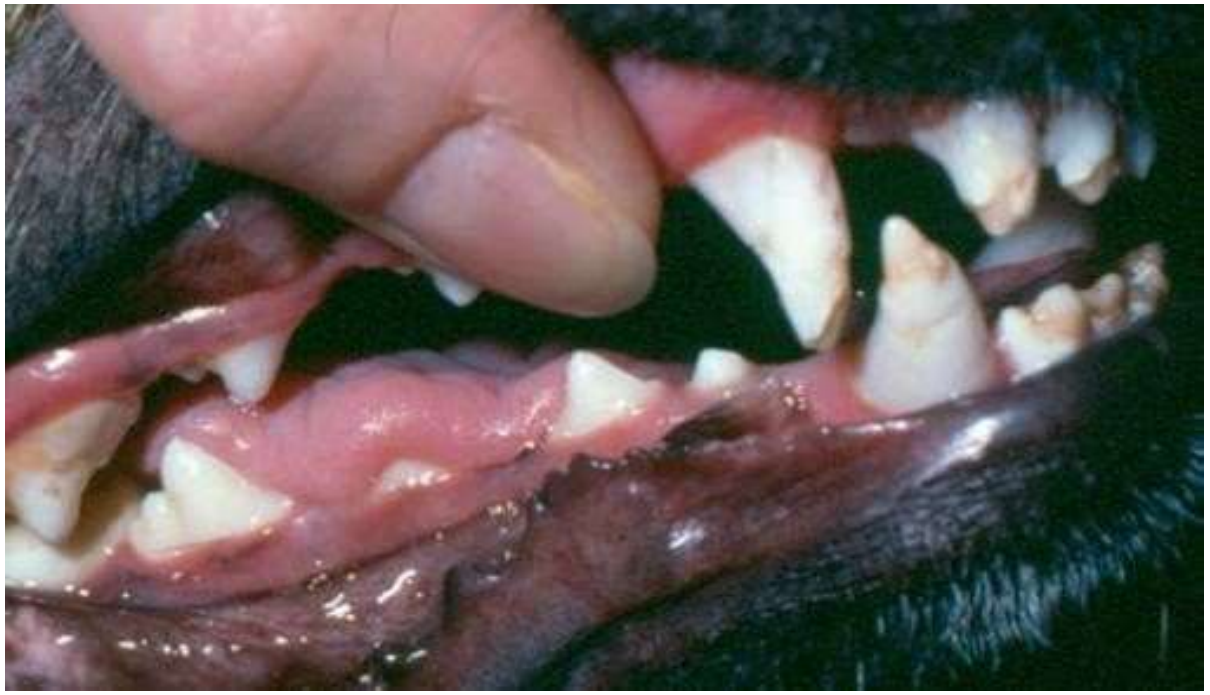
➢ Persistence of CDV

- ❑Ocular signs: Uveitis, chorioretinitis, dry keratoconjunctivitis (KCS), keratitis, optic neuritis = Blindness.
- ❑Hard Pad Disease.
- ❑Old Dog Encephalitis (ODE): Rare, Chronic Inflammatory grey matter of the cerebral hemispheres and brainstem of the CNS Neurological symptoms (ataxia then paralysis).

➢ Other clinical manifestations

Subacute infection:

- ❑ Alterations in the development of permanent teeth (Young): Enamel hypoplasia.
- ❑ Hyperkeratosis Pad and Paw Pads = "Hard Pad Disease" Rare During or after the 2nd week of the disease + Neurological disorders → High mortality.
- ❑ Vesicular and pustular dermatitis → Thighs, abdomen ventral.
- ❑ Abortion, stillbirth, metaphyseal osteosclerosis of long bones (young).



Enamel hypoplasia: Irregularities of the dental surface in an older dog that survived neonatal distemper.

Pustular dermatitis in a puppy affected by the distemper. Rarely associated with neurological complications; generally regarded as a favorable prognostic sign.

Nasal hyperkeratosis in a dog affected by systemic disease.

Canine

Digital hyperkeratosis (hard pads) in a dog dying from encephalomyelitis of Canine Distemper.

➢ Outcome of the disease

Classic forms of the infection are often fatal; they develop over a period of 3 to 5 weeks.

Multiple outcomes

Possible outcomes include:

- ❑ Recovery.
- ❑ Recovery with sequelae (myoclonus, epilepsy, retinochoroiditis, interstitial pneumonia, absence of dental enamel).
- ❑ Death.

Diagnosis

Clinical diagnosis

- Infection with CDV easily goes unnoticed if the combination of respiratory, gastrointestinal, and CNS (myoclonus) signs is absent.
- When simultaneously or within a short period, 4 of the following clinical criteria are met, the diagnosis of Canine Distemper is highly likely:

- ❑ Persistent hyperthermia.
- ❑ Oculo-nasal catarrh and other respiratory symptoms.
- ❑ Digestive symptoms.
- ❑ Nervous symptoms.
- ❑ Skin symptoms.

Differential diagnoses for canine distemper virus infection.

RESPIRATORY SIGNS	ENTERIC SIGNS	NEUROLOGIC SIGNS
Canine influenza virus Canine parainfluenza virus Canine respiratory coronavirus *Bordetella bronchiseptica* *Streptococcus zooepidemicus* *Mycoplasma* spp. Canine adenovirus-2 Canine pneumovirus	Viral: canine parvovirus, coronavirus Bacterial GI disease (e.g. *Salmonella, Clostridium, Campylobacter*, etc.) Parasitic and/or protozoal disease (e.g. *Giardia, Cryptosporidium, Ancylostoma caninum, Toxacara canis, Toxascaris leonina*, etc.) Foreign body, dietary indiscretion and/or intussusception	Toxin: metaldehyde, strychnine, lead, ethylene glycol Metabolic: hypocalcemia, portosystemic shunt, hypoglycemia Non-infectious inflammatory: granulomatous meningoencephalitis, Pug encephalitis Infectious: rabies, toxoplasmosis, *Neospora, Cryptococcus*

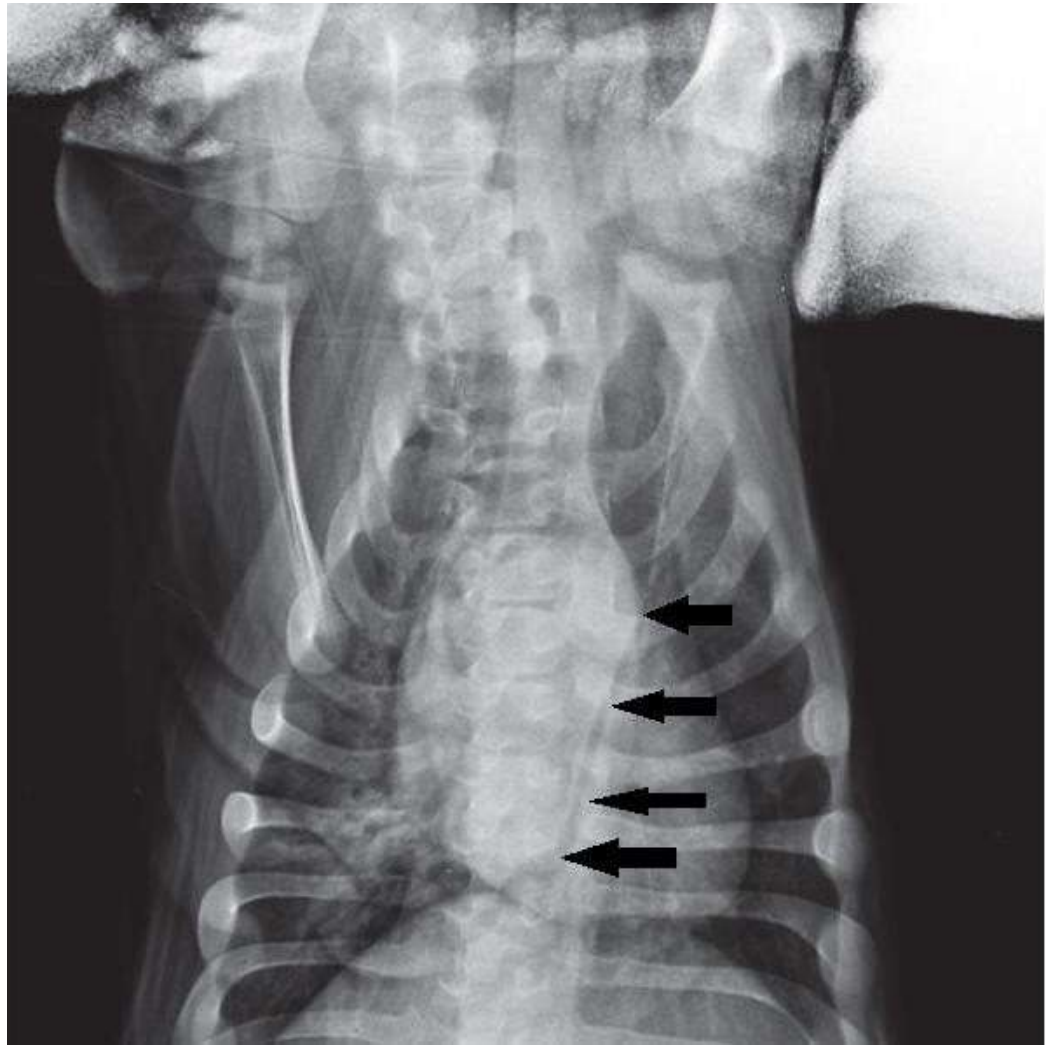
Additional examinations

- Suspicion of distemper → Tests and/or Techniques Confirmation:
  - Chest X-rays → Pneumonia.
  - Haematology → Complete blood count "CBC" White blood cell count.

  - Analysis of cerebrospinal fluid (CSF) → Neurological signs.
  - Serum biochemistry.
  - Serology.
  - Molecular biology (RT-PCR: Reverse transcriptase PCR).
  - Isolation of the virus.
  - Rapid tests.
  - Pathological examination (demonstration of Lentz bodies, immunofluorescence, immunohistochemistry).

Bronchopneumonia

- **Chest X-ray**



Frontal chest X-ray of a dog affected by distemper showing signs of pulmonary parenchymal involvement: Alveolar pattern (black arrows), sign of bronchopneumonia.

- **Hematology**

Complete blood count (CBC) Lymphopenia***

- **Biochimie sérique** = Pas spécifiques

- **Hyponatrémie, hypokaliémie, hypochlorémie** = Vomissements , diarrhée

- Hypoalbuminémie, hypocalcémie

- **Analyse du liquide céphalo-rachidien (LCR)**

Augmentation du nombre de cellules (lymphocytes et monotyes) et/ou [Protéines] = **Atteinte du SNC.**

Complete Blood Count Findings at Admission in 50 Dogs Diagnosed with Distemper at the UC Davis VMTH

Test	Reference Range	Percent below the Reference Range	Percent within the Reference Range	Percent above the Reference Range	Range for Dogs with Distemper
Hematocrit (%)	40-55	80	20	0	17-53
MCV (fL)	65-75	26	72	2	58-80
MCHC (g/dL)	33-36	10	74	16	28-37
Neutrophils (cells/µL)	3000-10,500	12	32	56	16-27,765
Band neutrophils (cells/µL)	0-rare	0	72	28	0-4442
Monocytes (cells/µL)	150-1200	4	62	34	24-5202
Lymphocytes (cells/µL)	1000-4000	54	42	4	110-5575
Eosinophils (cells/µL)	0-1500	0	100	0	0-1114
Platelets (cells/µL)	150,000-400,000	14	66	20	17,000-594,000

Note: Adult reference ranges were used.

Findings on Serum Biochemistry Analysis in 27 Dogs with Distemper at the UC Davis VMTH

Test	Reference Range	Percent below the Reference Range	Percent within the Reference Range	Percent above the Reference Range	Range for Dogs with Distemper	Number of Dogs Tested
Sodium (mmol/L)	145-154	56	40	5	106-158	26
Potassium (mmol/L)	3.6-5.3	12	79	9	2.8-5.9	26
Chloride (mmol/L)	108-118	40	56	5	65-130	26
Bicarbonate (mmol/L)	16-26	0	86	14	16-34	26
Calcium (mg/dL)	9.7-11.5	25	68	7	5.1-12.7	27
Phosphorus (mg/dL)	3.0-6.2	7	50	43	2.6-10.0	27
Creatinine (mg/dL)	0.3-1.2	11	89	0	0-1.2	27
BUN (mg/dL)	5-21	7	91	2	0.6-25	27
Albumin (g/dL)	3.0-4.4	68	32	0	0.9-3.7	27
Globulin (g/dL)	1.8-3.9	7	82	11	1.5-5.3	27
Cholesterol (mg/dL)	135-361	9	86	5	88-385	26
Total bilirubin (mg/dL)	0-0.2	0	80	20	0-0.8	26
ALT (U/L)	19-67	7	75	18	8-389	26
ALP (U/L)	21-170	0	77	23	28-322	26

Note: Adult reference ranges were used by the laboratory.

➢ **Serology → Detecting antibodies**

- ❑ Sero-neutralisation test
- ❑ IgM and IgG (Blood; CSF) → Immunofluorescence test indirect (IFAT), ELISA
- ❑ Serology For confirmation diagnosis Unreliable → No distinction between naturally acquired CDV infection and infection by a vaccine strain:
- ❖ 4-fold increase in antibody titre over a period of 2 to 4 weeks confirms an acute phase of infection.

→ Allows determination of the level of protection (Vaccines)

- **Molecular biology**

To establish a definitive diagnosis, it is advised to perform an RT-PCR from samples of blood, secretions, or tissues taken from a suspected case

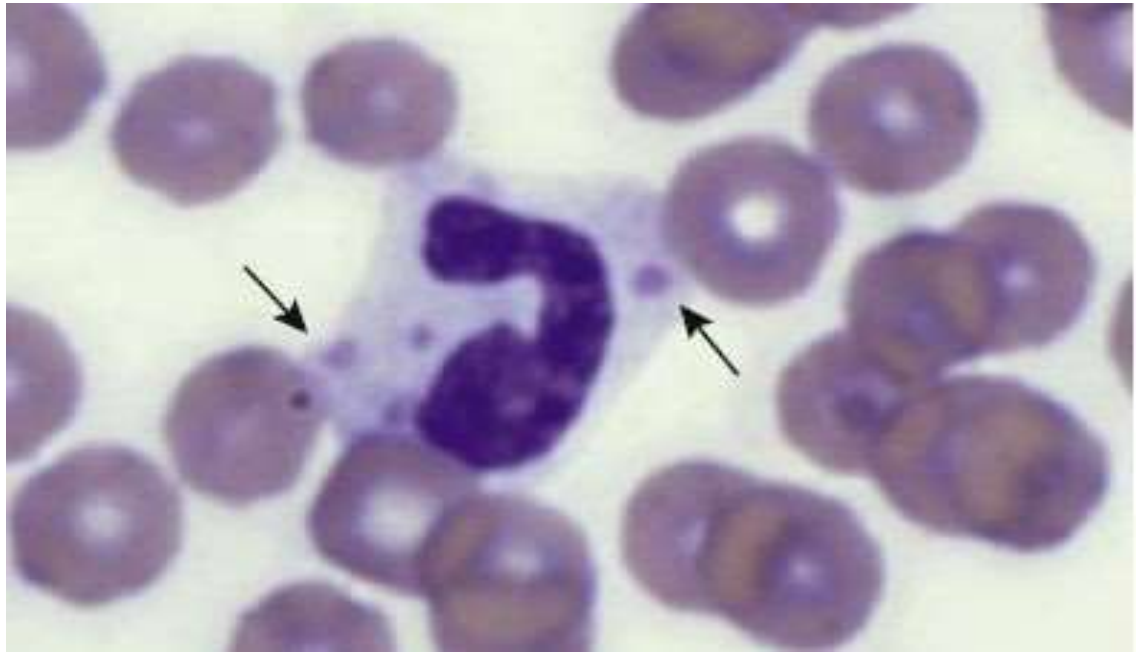
- **Virus isolation Research tool**

- **Rapid tests: Example Speed Distemper - VirbacTM (direct rapid test/immunochromatography)**

- **Pathological examinati → Demonstration of Lentz body**

Romanowsky intracytoplasmic → Cells of affected dogs = Staining of inclusions:

- ❑Living animal: Vaginal, urethral, conjunctival smear. Circulating blood cells.
- ❑Dead animal: Lung, lymphoid tissue, bladder, kidney, 3rd eyelid, intestine, cerebellum, brain.



Intracytoplasmic inclusions (arrows) in a circulating leukocyte from a 4-month-old Border Collie affected by Distemper.

Prognosis

- The mortality rate varies = Very high in young puppies, especially those with high fever, severe multisystemic disease, severe pneumonia, or progressive neurological disease.
- Neurological deficit caused by CDV is often progressive and irreversible.
- It is justified to recommend euthanasia for patients showing severe, irreversible, and progressive neurological signs.

Treatment

No specific treatment is currently available.

Symptomatic treatment:

- ❑ Isolate the patient to prevent infection of other dogs.
- ❑ Treat respiratory complications with the administration of broad-spectrum antibiotics to combat a secondary bacterial infection.
- ❑ Treat gastroenteritis: → Vomiting, diarrhoea → Antiemetics, antidiarrhoeals,
- ❑ IV fluid therapy.
- ❑ Nutritional support.
- ❑ Myoclonus, Convulsions → Dexamethasone (1–2 mg/kg IV) CNS oedema + Anticonvulsant Benzodiazepines (diazepam or midazolam) → Severely affected patients → Phenobarbital or propofol infusions.

Management of treatment for bronchopneumonia in dogs.

Clean, warm room that is free of drafts
Sedation or anxiolytics to reduce stress and fear may be considered
Nebulization and coupage for pneumonia as indicated
Intravenous fluid support to correct and prevent dehydration from systemic signs
Parenteral medications and antiemetics if vomiting and nausea are present
Nutritional support. This may need to be in the form of nasal or esophageal tubes to support requirements during recovery and also reduce risk of aspiration and resultant worsening of pneumonia. Force feeding is not advised owing to high risk of aspiration
Anticonvulsants to reduce seizures and risk of hyperthermia. Some dogs may benefit from a single anti-edema dose of dexamethasone. Suggested drugs to reduce seizures include benzodiazepines (diazepam or midazolam). Severely affected patients may require constant rate infusions of phenobarbital or propofol. Maintenance therapy with phenobarbital or potassium bromide may be required
Soft bedding, gentle cleaning and removal of ocular and nasal discharge, and ocular lubricant depending on patient need

➢ Medications used:

- ❑ Antibiotics: Antibiogram results → Ampicillin, amoxicillin/clavulanic acid, ampicillin/fluoroquinolone, UnasynTM (ampicillin + sulbactam) /fluoroquinolone, cephalosporin (cephalexin), doxycycline, sulfonamides (sulfadiazine-trimethoprim), etc.
- ❑ Anticonvulsants: Benzodiazepines (diazepam, levetiracetam, midazolam), phenobarbital, potassium bromide, propofol.
- ❑ Steroidal anti-inflammatories: Dexamethasone, prednisolone.
- ❑ Anti-emetics and anti-diarrhoeals.
- ❑ Rehydration serum: Ringer's lactate solution, isotonic NaCl solution (sodium chloride 0.9%).
- ❑ Vit A, B complex vitamins (B12, B1), Vit E, Vit C.

- Other recommended treatments:

- Serotherapy: Homologous serum (horse serum; 2ml/kg IV or SC; repeat dose 2 to 4 days later) is effective only in the early phase of the disease and should be reserved for the passive immunisation of unvaccinated animals in which a first case has been observed.
- Flavonoids: Antiviral activity against CDV in cell culture has been demonstrated for several flavonoids and phenolic compounds (plant extracts).
- Fucodans: Sulfated polysaccharides extracted from the edible brown algae Cladosiphon okamuranus. Analyses conducted in cell culture have shown that fucoidan possesses antiviral properties, highly selective against CDV.
- Botulinum toxin Treatment of myoclonus (encephalitis) Repeated injections (0.3 UI/muscle-45 UI/muscle) into the muscles affected by myoclonus, until the clinical signs disappear (every 3 to 6 months).

Some molecules used in the symptomatic treatment of canine distemper.

Molécule		Dose (mg/kg)	Voie	Intervalle (Heures)	Durée (Jours)
Antibiotique					
Ampicilline, amoxicilline		20	PO, IV, SC	8	7
Doxycycline*		5-10	PO, IV	12	7
Chloramphénicol		40-50	PO, SC	8	7
Florfénicol		25-50	SC, IM	8	3-5
Céphapirine		10-30	IM, IV, SC	6-8	3-5
Anticonvulsant					
Diazepam		0.5-2	Intra-rectale		
Phénobarbital		10-20 ; puis 2-8	IV PO	Une fois/12	A effectuer selon les besoins
Anti-inflammatoire					
Dexaméthasone	Œdème du SNC	1-2	IV	24	1
	Névrite optique	0,1	PO, IV, SC	24	3-5

Antiémétiques				
Métoclopramide	0,2-0,5	PO, IM, SC	q8h	
	1–2	IV	q24h, en perfusion IV à débit constant	Au cours de l'hospitalisation
Ondansetron	0,1–0,2	SC	q8h	Jusqu'à l'arrêt des symptômes
	0.5–1	PO	q6–12h	
	0,5	IV	en perfusion, q1h	Au cours de l'hospitalisation
Anti-diarrhéiques				
Bromure de prifinium (Prifinial™)	0,75-0,94 mg/kg	IM, IV, SC	q6 -12h	Au moment de la consultation ; Au cours de l'hospitalisation
Loperamide (Imodium™)	0,1–0,2	PO	q6–8h	Jusqu'à l'arrêt des symptômes

*IM : Intramusculaire ; IV : Intraveineux ; PO : Voie orale ; SC : Sous-cutané ; q6 -12h : Chaque 6 à 12 heures ; */ Chez les chiens de moins de 6 mois, la coloration dentaire présente moins de problème avec la doxycycline qu'avec la tétracycline ; **/ La dose équivalente de prednisolone en mg/kg est de 5 fois cette dose.*

Prophylaxis

Sanitary prophylaxis

Easy sanitary prophylaxis

CVD is not very resistant to the environment.

Bleach, Formaldehyde, Phenol, etc. Disinfect the premises.

Reduced sanitary emptying for about 1 week

After disinfection of a room or cage.

Isolate healthy populations Quarantine for 12 days for the animals to be introduced with monitoring of their temperature curve.

Medical prophylaxis

➢ Immunisation passive

- ❑ Use of homologous serum (1ml/kg SC or IM), provides immediate immunity for approximately 2 weeks.
- ❑ In a population of unvaccinated dogs that have been in contact with a dog suspected of having canine distemper.

➢ Vaccination

- ❑Newborn puppy acquires passive immunity against CDV from the mother, based on qualified antibodies known as 'Maternal Origin Antibodies' (MOA).
- ❑The majority of MOA comes from colostrum.
- ❑MOA protect the puppy until the age of two months, then gradually disappear between 8 and 14 weeks.
- ❑MOA interfere with the administered vaccine and neutralise it, hindering the response to vaccination.
- ❑Most puppies lose their maternal passive protection between the ages of 6 to 12 weeks, vaccination should commence during this period.

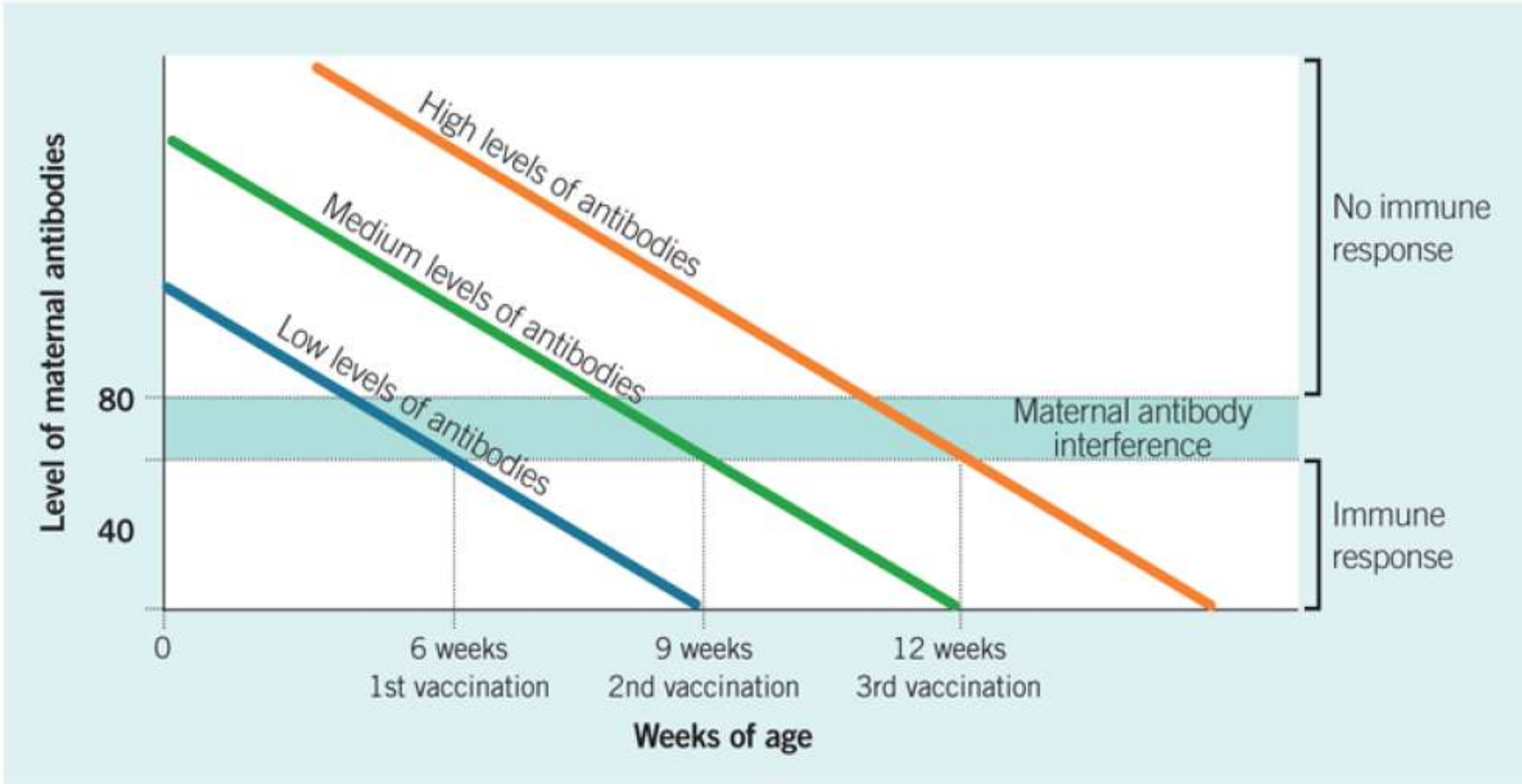
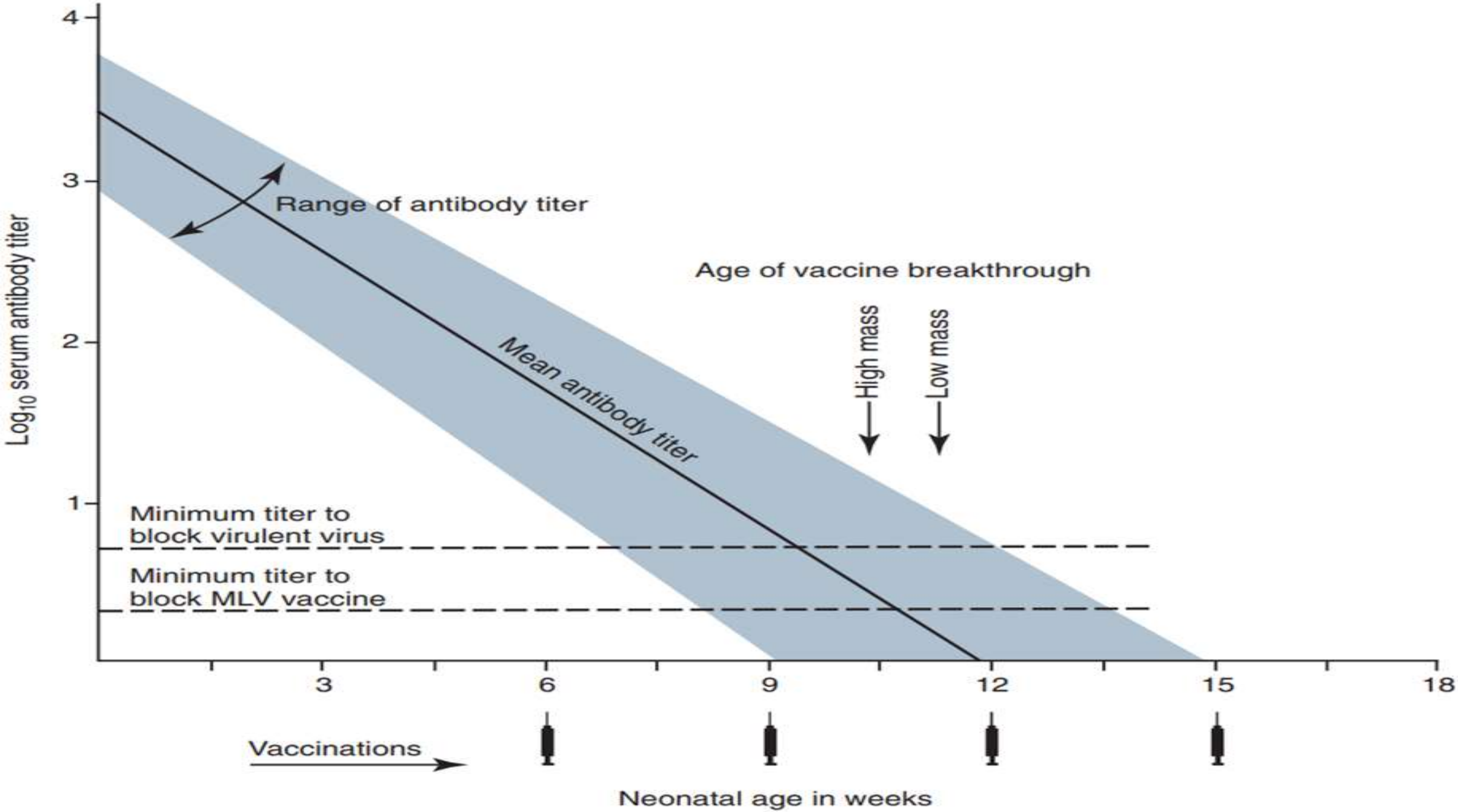


Figure 3. Relationship between maternal antibody levels and vaccination success.


4
3
2
1
Log10 serum antibody titer
Range of antibody titer
Mean antibody titer
Age of vaccine breakthrough
High mass
Low mass
Minimum titer to block virulent virus
Minimum titer to block MLV vaccine
3
6
9
12
15
18
Vaccinations
Neonatal age in weeks

Guidelines for Vaccination of Individual Pet Dogs

Vaccine	Initial Vaccination		Booster Schedule	Comments
	Age ≤ 16 Weeks	Age > 16 Weeks		
CDV (A, SC)	6-8 weeks of age, then every 3-4 weeks until no sooner than 14-16 weeks (16-20 weeks in breeding kennels)	Two doses 3-4 weeks apart recommended, but one dose is considered protective	1 year, then every 3 years thereafter	*Core.* Protection after the 12-month booster may be lifelong. Administer with CPV and CAV-2 vaccines.
CDV (Recombinant, SC)	6-8 weeks of age, then every 3-4 weeks until no sooner than 14-16 weeks (16-20 weeks in breeding kennels)	Two doses 3-4 weeks apart recommended, but one dose is considered protective	1 year, then every 3 years thereafter	*Core.* Can be interchanged with the attenuated live vaccine. May immunize in the face of maternal antibody. Administer with CAV2 and CPV vaccines.

A, attenuated live; I, inactivated whole organism; ; SC, subcutaneous.

Guidelines for Vaccination of Dogs in Shelter Environments

Vaccine	Initial Vaccination		Recommendations for Booster at Exit	Comments
	Age ≤ 16 Weeks	Age > 16 Weeks		
CDV (A, SC)	On entry no earlier than 6 weeks of age,* then every 2-3 weeks until no sooner than 16 weeks (up to 20 weeks when outbreaks occur)	Two doses 2-3 weeks apart recommended, but one dose is considered protective	1 year, then every 3 years thereafter	*Core.* Potential to provide strong protection. Do not use in pregnancy. Administer with CPV and CAV-2 vaccines.
CDV (recombinant, SC)	On entry no earlier than 6 weeks of age,* then every 2-3 weeks until no sooner than 16 weeks (up to 20 weeks when outbreaks occur)	Two doses 2-3 weeks apart recommended, but one dose is considered protective	1 year, then every 3 years thereafter	*Core.* Administer with CPV and CAV-2. Potential to provide strong protection and immunize pups in the face of maternal antibody. More studies needed that compare the relative efficacy of recombinant and live attenuated CDV vaccines in dogs of all ages in shelter environments.

A, attenuated live; I, inactivated whole organism; ; SC, subcutaneous.

*Immunization can be performed as early as 4-5 weeks in the face of an outbreak.

Implication for public health

Infection with the canine distemper virus is not considered a zoonosis.