Diagnosis and Management of Canine Distemper in Indigenous Dog

A Clinical report submitted in partial satisfaction of the requirement for the Degree of Doctor of Veterinary Medicine (DVM)

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Abbreviation and symbol	Elaboration
CDV	Canine Distemper Virus
Ag	Antigen
RT-PCR	Reverse Transcription Polymerase Chain Reaction
IgG	Immunoglobulin G
CVASU	Chattogram Veterinary and Animal Sciences University
Dr	Doctor
DVM	Doctor of veterinary Medicine
Etc.	Et cetera
et al.	et alia (and others)
SSC	Senior School Certificate
HSC	Higher Secondary Certificate
SAQTVH	S. A. Quadery Teaching Veterinary Hospital
TTPHRC	Teaching and Training Pet Hospital and Research Centre
RV & F	Remount Veterinary & Farm

Abstract

Canine Distemper is one of the most dangerous and contagious viral disease a dog could contract. This is a typical multi system affecting illness that can severely affect the CNS in dogs. Ferrets, raccoons, big cats, and other animal species are also susceptible to the virus's pathogenicity. In different species, the disease's severity varies noticeably. It is also one of the most preventable diseases of the canine. Canine distemper (CD) can be transmitted through direct contact or airborne exposure. The aerosol droplets released by an infected dog or wild animal when it coughs, sneezes, or barks spread the disease to nearby animals and objects like food and water bowls.

A dog showing typical neurological sign of CD was brought to the TTPHRC for treatment. After further diagnostic tests for confirmation doctors pointed the diagnosis to be Canine Distemper. The dog was provided with treatment but did not survive. Another two dog of the same owner showed the same signs and were diagnosed with CD after one week. They were treated with the same medications, where the first one died and the second one survived.

Keywords: Canine Distemper, Diagnosis, Treatment, Vaccination

Chapter 1: Introduction

Amongst the common communicable diseases in canids, Canine Distemper has fatality rate next to Rabies causing respiratory, digestive, neurological, cutaneous, and immunological difficulties in infected animal (Beineke, 2015). It is a major conservation threat to many endangered animal populations of earth. It endangers both domestic and wild animals and has the potential to cross species boundaries (kapil & Yeary, 2011) (Martinez-Guterrez & Ruiz-Saenz, 2016) .

This virus is a major veterinary health concern in areas with a high proportion of unvaccinated dogs and the virus is also prevalent among wildlife. Dogs of all ages are susceptible but young ones are more susceptible to infection. Dogs of young age are most likely to succumb to the disease quickly. The virus is primarily transmitted among dogs through bodily fluids such as respiratory droplets, saliva, urine, and feces, as well as through direct contact (Greene, 2012). Canine distemper virus (CDV) is a single-stranded RNA virus with an envelope that belongs to the order *Mononegavirales*, family Paramyxoviridae, and genus Morbillivirus. It shares similarities with the viruses that cause measles in humans and rinderpest in ungulates.

The word distemper is derived from the Middle English “distemperen”, which means "to upset the balance of the humors," and is derived from the Latin “dis” and “temperare”, which mean "to not mix properly”. Canine distemper is also known as "hardpad disease" in dogs as it causes hardening of the footpads and nose in infected dogs (Terio KA, 2013). Canine distemper has been known since at least 1760 and is found all over the world. Canidae (dog, fox, wolf, raccoon dog), Mustelidae (ferret, mink, skunk, wolverine, marten, badger, otter), Procyonidae (raccoon, coatimundi), Viverridae (palm civet), Ailuridae (red panda), Ursidae (bear), Ursidae (Domestic and feral dogs are thought to be the most important reservoir host species. Closely related viruses cause a similar disease in seals, as well as porpoises and dolphins (phocine distemper virus) (cetacean morbillivirus).

CDV is a serious threat to endangered wildlife, and it is expected to worsen with increased human encroachment (along with other factors) (Whitehouse, 2015). Incidence of CDV-related disease in canine populations worldwide appears to have increased in recent decades, and several cases of CDV disease in vaccinated animals have been reported (Decaro N, 2004).

A single-envelope-associated protein (M), two glycoproteins (the hemagglutinin H and the fusion protein F), two transcriptase-associated proteins (the phosphoprotein P and the large protein L), and the nucleocapsid protein (N) that encases the viral RNA are all encoded for by the CDV's enveloped virion, which also contains a nonsegmental negative-stranded RNA genome (Van Regenmortel HVM, 2000). The majority of CDV field strains can be classified into six major genetic lineages, known as America-1 and -2, Asia-1 and -2, European, and Arctic, based on the genetic diversity in the H gene (Martella V, 2006) regardless of the species' origin, that are variously distributed according to geographic patterns.

Like how the common cold is spread among humans, canine distemper can be transmitted through direct contact or airborne exposure. The aerosol droplets released by an infected dog or wild animal when it coughs, sneezes, or barks spread the disease to nearby animals and objects like food and water bowls. Transplacental transmission is possible too. The good news is that most disinfectants can effectively eliminate the virus because it does not persist for very long in the environment. Unfortunately, dogs with distemper can shed the virus for up to several months, endangering dogs nearby (Burke, 2022). A systemic and/or nervous clinical course, as well as viral persistence in specific organs like the lymphoid tissue and central nervous system (CNS), are characteristics of canine CDV infection. Immunosuppression, respiratory and gastrointestinal symptoms, as well as demyelinating leukoencephalomyelitis, are the main symptoms (DL).

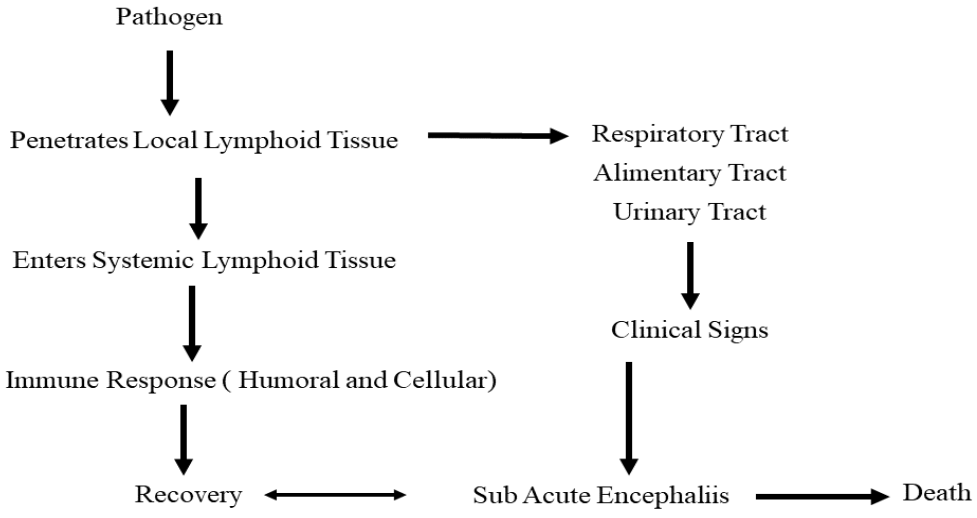

Figure 1 Pathogenesis of CD

Canine Distemper symptoms include conjunctivitis resulting in swollen, painful, and discharge-filled eyes that are white or clear. Sneezing and (rhinitis) Some canines might lose their vision or turn blind. Typically, affected dogs exhibit pyrexia (>104° F, 40° C), depression, and anorexia. Typically, a dry cough appears first, followed by a moist or "wet" cough. Pneumonia brought on by other infections can also cause breathing problems. During the first phase, Vomiting, Diarrhea, and nausea is observed in both acute and subacute infection. During advanced viremic stage, encephalitis and meningitis is found, which are inflammations of the brain's surrounding membrane. Even weeks after the dog first contracted CDV, the symptoms of this condition can occasionally be delayed. Seizures, poor coordination, and trembling in the muscles are symptoms of illness. At least 50% of CDV infections are thought to be subclinical, and dogs may shed the virus for up to 60 days after infection. (W.B. SAunders, 2013).

The immune system is attacked and weakened by CDV, which reduces the dog's resistance to or capacity to combat other infections. When they grow up to be adult dogs, puppies with distemper may have abnormal teeth, such as ones that are permanently pitted and discolored. Aside from weak puppies being born, CDV can also result in abortion and stillbirth. Cardiomyopathy and cardiac failure can develop less than three weeks after a newborn infection in puppies older than one week old (W. B. Saunders, 2013).

Chapter 2: Materials and Methods

2.1 Case History and observations

This report discusses the case of three indigenous dog, who were diagnosed with Canine Distemper.

The name of the first infected dog was Lalu, who was brought to Teaching and Training Pet Hospital and Research Center of CVASU at Purbachal, Dhaka on 31st October 2022 by his owner with a complaint of undergoing a stroke. Lalu was a 10-year-old male dog. The dog was kept in poor condition with another 6 dogs, near the Baridhara Residential area, Dhaka. Lalu had severe seizures when he was brought to the hospital with a rapid tremble at the back of the head, salivation, and lacrimation from the day before coming to the hospital. Clinical signs included progressive and severe ataxia, paresis, depression, and generalized or "chewing gum" seizures (focal seizures involving biting movements of the mandible). His hair coat was rough, and the dog was severely dehydrated. Lalu had 101.6°F temperature and difficulty while breathing.

Radiography for both right and left lateral view of thoraco-cervical and lumber region at 8.0 mA and 58 KV was done to detect any abnormalities that causing difficulty of breathing.

Figure 2 Right lateral view of thoracic and cervical region

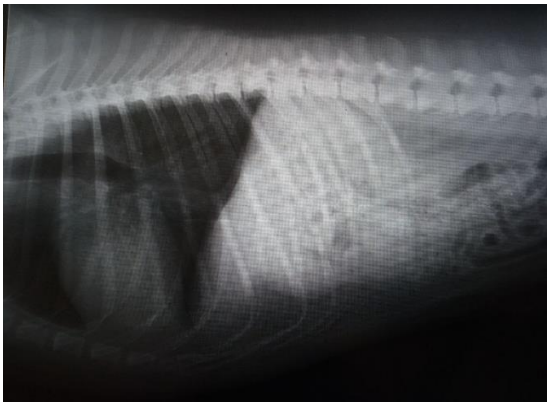

Figure 3 Left Lateral View of Thoracic and abdominal region

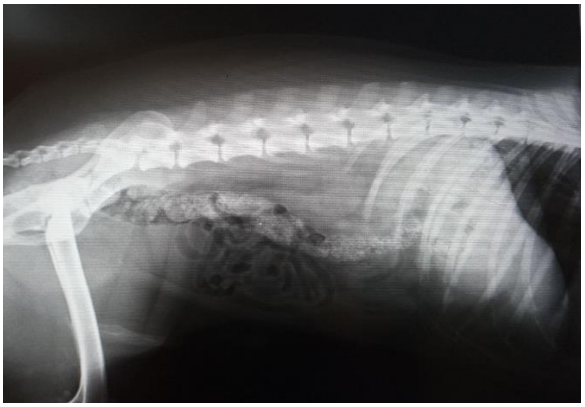

Figure 4 Right lateral view of Lumber region

Figure 5Left lateral view of lumber region

On 25th October 2022 Lalu was vaccinated with a combined live vaccine (Novibac Rabies) along with another 52 dogs on a free vaccination camp. The dog has no recent deworming history. Lalu started to show signs very suddenly and rapidly from 30th October 2022 and was brought within 24 hours of showing signs of disease after some preliminary medication with steroid drug. Lalu was diagnosed with CD after regular physical examinations, hematology, and rapid kit test.

Within one week another two dogs of the same herd started showing similar signs subsequently. One of them was male and another one was female. Both dogs were aged more than 9 years, and both were of indigenous breed. Diagnosis for these digs were also done after physical examination, hematology, and rapid kit test.

2.2 Laboratory Examination

a) Hematological tests

Any pathogen when infects a host causes change in blood parameters directly or indirectly to a different range (Diseases, 2011). So, hematology can be one of the diagnostic methods for both tentative and precise diagnosis of a disease. This case is another proof of the statement given in the cited paper, as there was noted change in the blood parameters evaluated for this case.

Blood samples was taken with aseptic measures from the Cephalic vein of the dog after proper restraining.

Coagulation time*:* test was done by using Glass slide method. After taking a drop of blood on the glass slide the time to form a clot was recorded.

Hemoglobin Concentration: 0.1 N Hydrochloric was added to the and kept for 5 minutes for Red Blood Cell Lysis. Hb concentration was determined by matching the color with Sahli's Standard.

Packed cell volume (PCV): Hematocrit centrifugation method was used for PCV determination.

Total red blood cell count (RBC): Total RBC was counted by using Neubeur Chamber Counting method.

Parameter	Mean Value (n=3)	Reference value
RBC (10^6/µl)	3.82	4.8-9.3
PCV (%)	24.3	35-57
Hb conc. (g/dl)	8.09	11.9 – 18.9
Clotting time (seconds)	104	<60 - 125

(Higgs, 2020) (Byars TD, 1976)

Table 1 Blood parameters found in Hematology

b) Canine Distemper Virus Antigen (CDV Ag) Rapid Kit Test

The CDV Antigen Rapid Test is a lateral flow immunochromatographic assay for the qualitative detection of CDV Ag in secretions from dog's eyes, nasal cavities, and anus or in serum, plasma specimen. Total assay takes about 5-10 minutes.

- Principle

  The CDV Ag Rapid Test is based on sandwich lateral flow immunochromatographic assay. The test device has a testing window for the observation of assay running and result reading. The testing window has an invisible T(test) zone and a C (control) zone before running the assay. When the treated sample was applied into the sample hole opn the device, the liquid will laterally flow through the surface of the test strip and react with the pre-coated monoclonal antibodies. If there is CDV Ag in the specimen, a visible T line will appear, and the C line should appear after any sample has been given in the sample hole. Hence, the device indicates positive specimen for CDV Ag.

- Reagent and Material

  Test devices, with disposable droppers, assay buffer, cotton swabs, products manual

- Test procedure

  Dog's ocular and nasal secretions were collected with the disposable cotton swab. The swab was wetted sufficiently.

Figure 6 collecting lacrimal secretion

Figure 7 collecting nasal swab

The swab was inserted into the provided assay buffer tube and agitated to get sufficient sample extraction.

Figure 8 Dipping the swab in the buffer solution and mixing vigorous

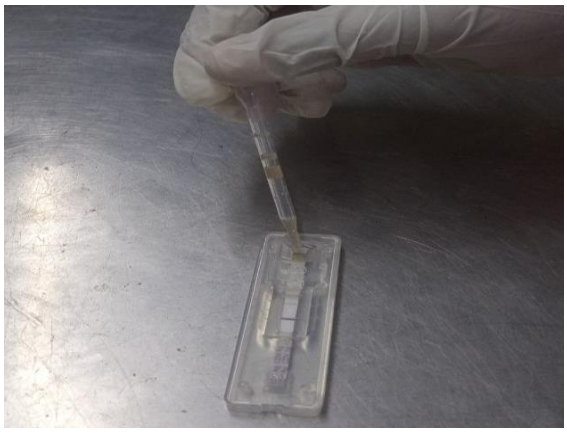

Figure 9 Putting sample in the sample hole

The test device was taken out from the foil pouch and placed horizontally. 3 drops of treated sample extraction were put in the sample hole “S” of the testing device. Result was interpreted after 10 minutes.

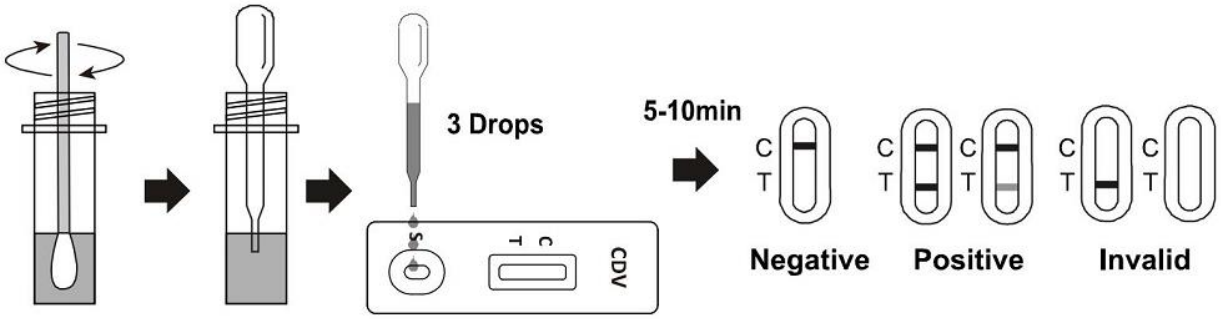

Figure 10 Illustration of the procedure manual

- Interpretation of the result

  Positive result requires both “C” line and “T” line to appear on the testing device.

  Result for this case was positive according to CDV Ag Rapid testing procedure.

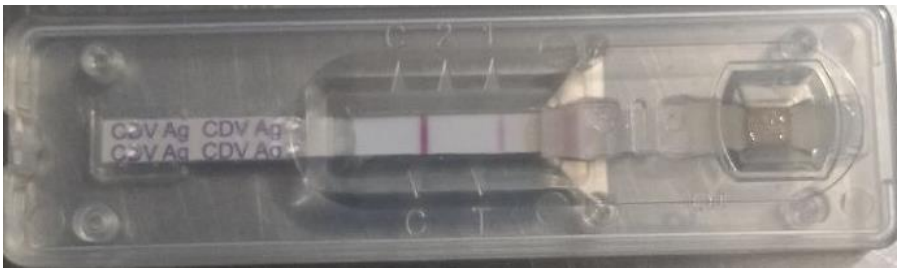

Figure 11 Both C and T line appearance in the kit

2.3 Diagnosis

Being a pantropic and immunosuppressive disease CD induces varied clinical signs in the host animal. It can be easily confused with some other diseases like Leptospirosis, Infectious Canine

Hepatitis, Lead poisoning, Parvo viral enteritis and Rabies (Udegbunam,2008). Early on distemper can often look like 'kennel cough' or canine influenza (dog flu).

Presumptive diagnosis was done after taking history and observing the clinical signs (e.g., fever, nasal and eye discharge, cough, and pneumonia). The dog had the characteristic signs of CD present, as – rapid seizure, vibrating feeling when touched the top of the head. For further conformation, physical examination was done to evaluate the clinical manifestation of the disease in the dog. Confirmatory diagnosis of CD was done after laboratory examination.

Hematology report reveals that there were lower PCV value and Total RBC count. The fact that dogs with canine distemper (CD) have lower total red blood cell counts and packed cell volumes suggests that CD caused these changes. Infected patients' bone marrow has been found to harbor the canine distemper virus (Udegbunam, 2008). As there are other anemia causing viral disease (e.g., Parvo viral disease) (Brock KV, 1989), Rapid test for CDV Ag was done with the conjunctival and nasal discharge. The dog was marked as CD positive after a positive result from the kit test. The dogs were then treated for Canine Distemper Virus.

2.4 Case Management and treatment outcome

Canine distemper infection is incurable. Supportive care, efforts to stop secondary infections, management of neurologic symptoms, vomiting, diarrhea, and fluid administration are typically the mainstays of treatment.

The goal of treatment is to stop the secondary bacterial infections that frequently occur in immunosuppressed animals and consists of supportive care and antibiotics. A purine nucleoside analogue called Ribavirin can prevent CDV replication in vitro, but there are no commercially available antiviral medications (Vito Martella, 2008).

As prime supportive therapy Hartmann solution was prescribed parenterally (intravenous) for five consecutive days. The solutions lack any additional buffers or antimicrobial agents, are sterile, non-pyrogenic, and are isotonic. They contain electrolytes like, sodium, potassium, chloride, calcium, bicarbonate (as lactate).

Amoxicillin (11mg/kg) was prescribed for 7 consecutive days. One of the most frequently prescribed antibiotics in the setting of primary care is amoxicillin. To combat antibiotic resistance,

an additional amino group was added to penicillin to create an amino penicillin. When compared to penicillin, amoxicillin offers slightly more gram-negative coverage while still treating a wide range of gram-positive bacteria (Akhavan, Khanna, & Vijhani., 2022).

Diazepam (1 mg/kg) was administered through rectum to stop the seizures when vigorous. The first-line drug of choice for the emergency management of seizures is frequently diazepam. Since intravenous access is challenging in patients who are having seizures, other administration routes have been sought.

Omega 3 fatty acid was suggested as dietary supplement as an aid to regain the normal condition of the affected systems.

Though the first two dogs did not survive as they were brought to medication at a very advanced stage of the disease, third one has recovered and still alive. The first dog, Lalu, died after 2 days of diagnosis of the disease and starting the medication. The second one died after 6 days of onset of the signs of CD. Third one showed sign in more mild form and survived after administration of antibiotics and supportive treatment for one week.

Chapter 3: Result and Discussion

Being a viral disease, Canine Distemper also has major immunosuppressive characteristics. Young dogs who are susceptible to acute distemper typically exhibit respiratory and gastrointestinal symptoms. Many dogs pass away before neurologic signs appear, though they may appear later in the clinical course. The most frequent neurologic manifestation is seizures (Michael D. Lorenz BS, 2011). But in this report, we can see all of the infected dogs were above 9 years old and two of them had shown acute signs of CD. The time between onset of the sign and death was around 5 days.

There is a significant lack of information regarding how other infections affect CDV pathogenesis. Due to the chronic nature of canine distemper, bone marrow pathology can result in non-regenerative anemia, as was the case in this report. The mean value of the total RBC count (10^6/µl) was 3.82 while the normal range of total RBC of a healthy dog is 4.8-9.3 (Higgs, 2020). PCV has also decreased, 24.3%, while the normal range is 35-57% (Higgs, 2020). Hemoglobin concentration by Sahli's standard should be 11.9-18.9 gm/dl (Higgs, 2020), but the test result shows 8.9 in the affected dogs. When in normal condition of a dog, blood clotting takes time about less than 60 to 125 seconds (Byars TD, 1976), it took 104 seconds for the blood collected from infected dogs to clot.

Production of inflammatory mediators, which could inhibit erythropoiesis and shorten RBC life span, is potential cause of the decreased total RBC count seen in canine distemper-infected dogs. The infection with canine distemper caused the macrophages to become more procoagulant (Udegbunam, 2008). The shortened clothing time noted in the cited study supports the reports of increased macrophage procoagulant activity. The Canine Distemper Virus Antigen Rapid test kit has a relative sensitivity of 97.96% (Canine Distemper Virus Ag Test, 2020). After adding sample in the hole both control line and true line appeared within 10 minutes, which indicates a positive Canine distemper case. CDV Ag was present in the infected dog's nasal and lacrimal secretion.

Treatment of CD is quite like any other viral diseases - Antibiotic to stop secondary bacterial infection, antiviral if available and supportive therapy. CD mostly needs fluid therapy, respiratory stimulant, Anticonvulsive, Gastrointestinal tract (GIT) medications like antiemetics, proton pump inhibitors, GIT protectant etc. (Tupler, 2020). In the above case, most of the severe signs shown

by the dogs were nervous. So, Diazepam through rectum was suggested until the convulsion stops or when the convulsion becomes rapid. Due to presence of severe dehydration, hence electrolyte imbalance, lactated saline solution (Hartmann) was prescribed to rehydrate the animal and increase its immunity. The chosen antibiotic was Amoxicillin to stoop secondary bacterial infection. Respiratory stimulants were not added as less affect in respiratory system was found in the X-ray report. But Omega 3 fatty acid was prescribed to aid the immune system (Gutiérrez S, 2019).

These dogs were not vaccinated against Canine Distemper. Prevention is better than treatment in case of CDV infection. Vaccine-based prophylaxis has significantly contributed to the control of the distemper disease (Appel MJ, 2004). Because the virus uses the H gene protein for attachment to cell receptors during the initial stage of infection, both CDV and its animal hosts depend on this protein (MJ., 1987) (Martella, Elia, & Buonavoglia, 2008). The infection of CDV may be avoided by a sufficient host immune response to the H protein (von Messling V, 2001) (Elia, et al., 2006). The F protein aids in the fusion of the viral envelope and cell membranes after attachment. Additionally, the F protein stimulates host cell membrane fusion, resulting in the formation of syncytia (Lamb RA, 2006). So, pre vaccination could be life savior for these dogs.

Again, there could be a previous latent infection that was triggered by the stress that was given during the Rabies vaccination program they were brought to 6 days before the onset of signs. Vaccinating an unhealthy dog or a dog with previous infection could be dangerous (Rasmusen, 2022). After all, older dogs usually survive this infection (Tupler, 2020). But in this two-dog aged over 9 years dies from CD.

It is also possible that, they got the infection from another infected dog from the same vaccination campaign.

Limitations

- There was not enough data about the recent vaccination program that was conducted 6 days before, to indicate the relation between the recent vaccination program and onset of the clinical case in the dogs.
- There was no proper history of the exact onset of the symptoms to know the exact time of infection and ways of transmission.
- RT PCR should be done, as it has 100% specificity whilst Rapid kit test has 97.50% and relative sensitivity of 97.96%.
- Serological tests could be done to evaluate antibody titer (IgG Ab levels) in blood.

Conclusion

The third dog in the report serves as an illustration of how a Canine Distemper -infected dog can be saved with an early diagnosis. Dogs with neurological symptoms, however, have a poor prognosis. Distemper should be high on the list of differential diagnoses for any dog with respiratory and/or CNS signs. Differential diagnosis with other canine disease is important.

Even after being diagnosed with CD the sick dogs were not kept isolated from the healthy ones. So, another two from the same group got infected. The author suggests to always isolate the sick animal from the healthy ones to prevent spread of infection.

In this case, the infection could be prevented by vaccinating the dog against CD early. Author suggests vaccinating the dogs against CD as older animals can also get infected and die from canine distemper.

There is a major role of the vaccination campaign these dogs participated a week ago for this case, – it could be stress during handling or transmission from another infected dogs. Owner should be conscious about gentle handling of animal and its health condition before vaccination. Additionally, the owner should be cautious about their pet encountering other animals during a large gathering like a campaign.

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Biography

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