World of Science: Journal on Modern Research Methodologies

Volume 2 Issue 2, Year 2023
ISSN: 2835-3072
https://univerpubl.com/index.php/woscience

Prevalence Study of Canine Infectious Hepatitis in Puppies and Adult Dogs in Basrsh Province, Iraq

Tariqe Hadi Abdullhussain

Department of Internal and Preventive Medicine, Collage of Veterinary Medicine, Basrah University- Iraq

Hussein Ali Naji

Department of Internal and Preventive Medicine, Collage of Veterinary Medicine, Basrah University- Iraq.

E-Mail: Hussein.naji@uobasrah.edu.iq

Article Information

Received: December 13, 2022
Accepted: January 22, 2023
Published: February 16, 2023

Keywords
canine adenovirus, CAV1, CAV2, Infectious canine hepatitis, hepatitis in puppies

ABSTRACT

The present study was planned to investigate about canine adenovirus1 (CAV1) by used sandwich ELISA in puppies and adults dogs, in addition to observed the clinical signs in infected dogs.

The current study conducted on 141 dogs, which included two groups according to age (adults and puppies), the first group adult group (64 dogs) unvaccinated dogs both sexs of different breeds and show the clinical signs of canine infectious hepatitis, in addition to (20 dogs) apparent clinically heathy as a control group. The second group (27 puppies) both sex, 1- 3 months of age were suffering from the clinical signs of canine infectious hepatitis, beside (20 puppies) unvaccinated were apparent clinically healthy consider as control group. The study conducted between September 2020 to April 2021 in Basrha province. The results of ELSIA in the dogs with a clinical symptoms of canine infectious hepatitis (adults and puppies) show (20/27) of puppies were positive to antibodies against CAV while (36/64) in adult dogs (male and females) were positive for antibodies against CAV. In total the prevalence of CAV antibodies in puppies (74.4 %) were higher than adult dogs (56.25).

In total 56 / 91 (61.5%) the sample were positive to antibodies against CAV in adult, puppies and both sex. The infected dogs show varies clinical signs, the clinical signs were sever in puppies than adults dogs.

1.1 Introduction

Infectious canine hepatitis (ICH) caused by Canine adenovirus type 1 (CAV1), The disease is typically found in puppies between the ages of eight weeks and a year, although adult dogs without vaccinations have also been reported to contract it(Vos et al. 2004; Watts and Benson 2016). In addition to dogs, other animals affected by this disease include wolves, ferrets, otters, foxes, coyotes, raccoons, pinnipeds, and bears(Gür and Acar 2009; Yoon et al. 2010; Chander et al. 2021). Virus susceptibility is not present in tame sacs(Ford 2012; Sykes 2013; Suderman et al. 2021).

The virus caused many clinical signs such fever, tachypnea, tachycardia, anorexia, congestion of mucous membrane, lethargy, conjunctivitis, inappetence, weakness, polydipsia, vomiting, hematemesis, diarrhea, cough, tonsillitis, tachypnea, and icterus of mucous membrane, diarrhea may contain frank blood or melen, nervous signs and death.

Adenoviruses (Ads) are non-enveloped DNA viruses having icosahedral symmetry(Robinson and Echavarria 2011; Ginsberg 2013). There are at least 47 recognized Ad serotypes, many of which are linked to gastrointestinal, ophthalmic, or respiratory diseases(Echavarría 2009; Usman and Suarez 2022). The Adenoviridae family was established and adenoviruses were divided into genera during the 1975 International Committee on Taxonomy of Viruses (ICTV) conference(Smith et al. 2010; Lynch, Fishbein, and Echavarria 2011; Rhee and Barouch 2015). Classification There are now five genera in the Adenoviridae family: Mastadenovirus, Aviadenovirus, Atadenovirus, Siadenovirus, Ichtadenovirus, Testadenovirus, the sixth genus.

In Basra_ Iraq we have little information and studies about the diseases therefore this study design for investigated about canine adino virus in puppies and Adult dogs in Basra province, in addition to study the clinical signs on infected dogs.

2. Materials and Methods

2.1 Animals and design of the study:

The current study conducted on 141 dogs, which included two groups according to age (adults and puppies), the first group adult group (64 dogs) unvaccinated dogs both sexs of different breeds and show the clinical signs of canine infectious hepatitis, in addition to (20 dogs) apparent clinically heathy as a control group.

The second group (27 puppies) both sex, 1- 3 months of age were suffering from the clinical signs of canine infectious hepatitis, beside (20 puppies) unvaccinated were apparent clinically healthy consider as control group. The study conducted between September 2020 to April 2021 in Basrha province.

2.2 Clinical sings:

Standard clinical cards were used for data collection, including, history of diseased animals, symptoms and the routine standard clinical investigation.

2.3 Blood Samples:

Blood was collected aseptically from the cephalic vein by 5 ml disposable syringe, Blood samples that were taken into normal tubes were centrifuged at 2000 rpm/15 min. The serums

obtained were kept in a deep freezer under −20°C. Serum samples were inactivated for 30 min at 56°C before being used for ELISA test.

2.4 ELISA (Enzyme-Linked Immunosorbent Assay)

Canine Adenovirus antibody (ADV-Ab) sandwich ELISA kit (Sunlong Biotech Co., Ltd/china) was used for detecting CAV antibodies in dogs. The test was performed as per the manufacturer's instructions. The plates were then read on an automatic plate reader at 450 nm.

2.5 Statistical Analysis

A one-way analyses of variance (infected dogs x control), a Tukey's post hoc test for pairwise comparisons to compare the responses between control and samples was used (SYSTAT for Windows version 11.00). All of the results are displayed as the mean ± SEM, and the data were considered significant when $p \leq 0.05$.

3. Results

The results of ELSIA in the dogs with a clinical symptoms of canine infectious hepatitis (adults and puppies) show (20/27) of puppies were positive to antibodies against CAV while (36/64) in adult dogs (male and females) were positive for antibodies against CAV. In total the prevalence of CAV antibodies in puppies (74.4 %) were higher than adult dogs (56.25).

In total 56 / 91 (61.5%) the sample were positive to antibodies against CAV in adult, puppies and both sex (table 1).

Table (1) the result of CAV antibody according to the age

Result / Age	Positive N & %	Negative N & %	Total N & %
Puppies	20 (74.4%)	7 (26.6%)	27 (100%)
Adult	36 (56.25 %)	28 (53.75%)	64 (100%)
Total	56 (61.5 %)	35 (38.5 %)	91 (100%)

In addition to the results of ELISA test in adult dogs according to the gender show the percent of samples were positive to antibodies against CAV in male 25/38 (65.78 %) higher than female 11/26 (42.3%) (table 2).

Table (2) the result of CAV antibody according to the gender

Result / Gender	Positive N & %	Negative N & %	Total N & %
Male	25 (65.78%)	13 (34.22%)	38 (100%)
Female	11 (42.3 %)	15 (57.7%)	26 (100%)
Total	36 (56.25 %)	28 (53.75%)	64 (100%)

The results of the clinical signs which observed in adult infected dogs with CV1 include Anorexia, congestion of mucous membrane, lethargy, conjunctivitis, inappetence, weakness,

polydipsia, vomiting, hematemesis, diarrhea, cough, tonsillitis, tachypnea, and icterus of mucous membrane, diarrhea may contain frank blood or melena, ecchymotic and petechial hemorrhages, hematuria, Abdominal palpation reveal abdominal pain, hepatomegaly or splenomegaly, some neurologic signs such as circling, head pressing, ataxia, seizures, nystagmus and apparent blindness (table 3).

Coagulopathies may be manifested as cutaneous or mucosal petechial hemorrhages; gingival hemorrhages; epistaxis; or prolonged bleeding from venipuncture sites. Ocular complications occur in at least 20% of affected dogs. Unilateral or, less commonly, bilateral corneal edema may be observed, which initially develops at the limbus and is occasionally associated with blepharospasm, photophobia, and a serous ocular discharge (table 3).

In puppies the clinical signs were more sever than adult dogs such as corneal odema (blue eye) Fig (1). encephalitis signs include ataxia, circling, , head pressing, , vocalization and blindness in addition the clinical signs which mention in above.

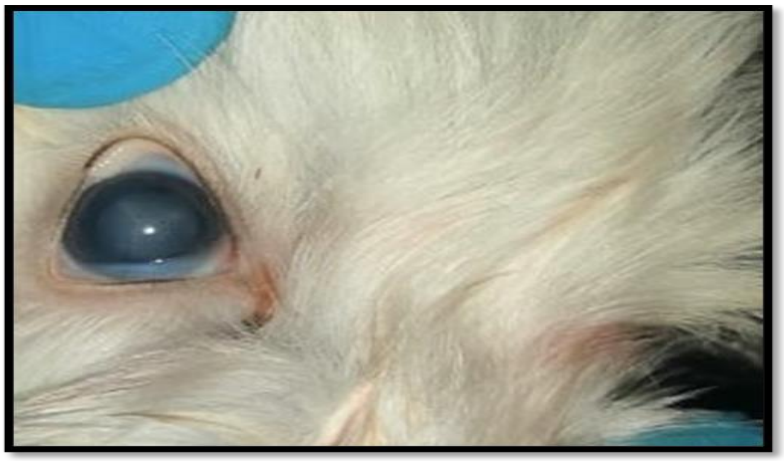

Figure (1) corneal edema (blue eye) in puppies

Table (3) the clinical signs observed in infected puppies and adult dogs.

The results of vital signs show significant increase ($p<0.01$) in body temperature, respiratory and heart rates, however capillary refilling time also increased significantly in diseased dogs (adult and puppies) when compared with control group (table 4 & table 5)

No.	Sings	Adults dogs N= 36 & %	Puppies N= 20 &100
1.	Anorexia	36 (100%)	20 (100%)
2.	Lethargy	33	19
3.	Polydipsia	29	19
4.	Weakness	24	19
5.	Diarrhea	22	17
6.	Icterus of M.M	22	16
7.	Congestion of mucous membrane	8	3
8.	Petechial hemorrhages	6	1
9.	Vomiting, hematemesis	12	13
10.	Cough, tonsillitis, tachypnea	20	15
11.	Bloody diarrhea or Melana	8	7
12.	Hematuria	6	7
13.	abdominal pain, hepatomegaly or splenomegaly	25	19
14.	Head pressing, ataxia	8	9
15.	Prolonged bleeding from venipuncture sites	17	13
16.	Nystagmus	5	9
17.	Seizures	11	5
18.	Blepharospasm, photophobia	5	11
19.	Corneal odema (blue eye)	4	6
20.	Encephalitis signs	20	16
21.	Death	1	8

Table (4) Body temperature, Respiratory rate, Heart rate, Capillary refilling time , in infected adults dogs compared with control group.

Parameters	Control n=	Diseased dogs n
Body temperature C°	38.4 ± 0.856*	41.4 ± 1.3**

Respiratory rate / mint	18.44± 3.48*	52 ± 2.88**
Heart rate /mint	112 + 9.24*	148 ± 11.4*

**P<(0.05) values are mean± standard error of mean*

Table (5) Body temperature, Respiratory rate, Heart rate, Capillary refilling time , in infected puppies compared with control group.

Parameters	Control n=	Diseased puppies n
Body temperature C°	36.8 ± 0.56*	40.4± 1.3**
Respiratory rate / mint	32.62± 5.38*	68.42 ± 6.32**
Heart rate /mint	158.36 + 14.82*	190 ± 18.66**

**P<(0.05) values are mean± standard error of mean*

4. Discussion

The results of serological test in the present study show the prevalence of CAV1 antibodies in puppies (74.4 %) were higher than adult dogs (56.25%), this results indicted the puppies more susceptible for infection than adults may be du to the depended on level of immunity and stress, this results corresponding with Bulut et al., (2013) , they suggested, puppies a despite if equipped with passive immunity through maternal antibodies but remain more susceptible for infection when exposed, and high mortalities rate may occur.

In addition to the results of ELISA test in adult dogs according to the gender show the percent of samples were positive to antibodies against CAV1 in male higher than female, this may be to the number of male in the present study more than female, indeed the male exposure for more stress than female.

The ELISA tests is a sensitive, reliable and fast and reliable way for investagation of anti-adenovirus antibody (Gür and Acar 2009; Naji and Zenad 2016) , in addition to some kits used for detect the antibody could not distinguish between CAV types 1 and 2. The discriminatory power of the test may be considered redundant as both natural infection and vaccination against either of the 2 types provide cross-protection, therefor (Gür and Acar 2009; K M Alsaad, Alsaad, and Al-Derawie 2010) reported the high percentage (100%) the prevalence of CAV antibody while in our study the prevalence of CAV1 antibody were (61.5%) because in present study use specific ELISA kit (sandwich) for CAV1 antibodies which differentiated between vaccinated or naturally infected dogs.

Recently some European studies reported the contaminated foods are play important role of the transmission routes of CIH [in dogs, Indeed, feeding dogs with kitchen waste or infected animal offal has been identified as an HEV risk factor in HEV transmission practice (Mazzei et al. 2015; Bernardini et al. 2022; Caballero-Gómez et al. 2022).

Clinical ICH infection is more severe in puppies , as compared with adults this supported our Elisa results may be due to the puppies have low level of immunity and don't exposure for in infection, this suggest agreement with Bulut et al., (2013) and De Jonge, Van Brantegem and

Chiers,(2020), they reported the clinical signs more sever which lead to death.

The results of the clinical signs which observed in infected dogs with CV1 include Anorexia, congestion of mucous membrane, lethargy, conjunctivitis, inappetence, weakness, polydipsia, vomiting, hematemesis, diarrhea, cough, tonsillitis, tachypnea, and icterus of mucous membrane, diarrhea may contain frank blood or melena, ecchymotic and petechial hemorrhages, hematuria, Abdominal palpation reveal abdominal pain, hepatomegaly or splenomegaly this result agreement with Sykes, (2014); Hornsey et al., (2019)(De Jonge, Van Brantegem, and Chiers 2020), they reported the ICH has three form per acut, acute and chronic form, the per acute form more common in puppies characterized with circulatory failure, coma, and death during 24 to 48 hours, while the acute from occur in both (puppies and adult dogs) characterized with high morbidity and cause mortality rate of around 10%-30%. Diseased dogs in acute from recover or die within a two week.

The chronic form that occurs in dogs with low immunity and death occurs due to hepatic failure within weeks or months (Sykes 2014).

In addition many of clinical signs in acute form include petechial ecchymotic hemorrhages and hematuria this signs indicated disseminated intravascular coagulation (DIC) in diseased dogs due to coagulation disturbance this result agreement with Müller et al. (2010); Knowles et al. (2018) Kamal M Alsaad, Jarad, and Lafta (2021), the authors reported diarrhea may contain frank blood or melena in diseased animals beside the clinical sings.

The neurological signs in infected dogs such as circling, head pressing, ataxia, seizures, nystagmus and apparent blindness, this may be occur due to accumulation the DIC, thrombosis and hemorrhage in brain this result agreement with (Naji, Ahmed, and Alsaad 2018; De Jonge, Van Brantegem, and Chiers 2020; Jarad and Abed 2020) they suggested the neurological signs occur du to encephalitis, thrombosis, intracranial hemorrhage and hepatic encephalopathy.

Blue eye (Corneal edema) occur in infected dogs specially puppies this results agreement with Headley et al., (2018); Naji et al., (2021), author suggested the corneal edema occur as a result for replication of virus within corneal endothelial cells specifically in first week of infection. The corneal edema occurs unilateral or bilateral, also may be lead to ocular complication such as serous ocular discharge, photophobia and blepharospasm.

Other the clinical signs include abdominal pain in diseased dogs due to hepatic or splenomegaly, this result agreement with Sykes, (2014); Pereira et al., (2021), they suggested the abdominal pian result from hepatic lesion or interstitial nephritis in infected dogs, which caused sever pian.

The results of vital signs show significant increase ($p<0.01$) in body temperature, respiratory and heart rates, these signs occur due to the viremia which lead to septic fever and caused increase in body temperature due to the inflammation, beside that the damage of hepatocyte and kidney cell lead to increase phospholipases in the cells membrane lead to formation the Arachidonic acid (ARA) , the archidonic acid breakdown cycalooxygenase 1&2 (cox1and cox2) lead to formation the thromboplastin and prostaglandin, prostaglandin products modulate the hypothalamic thermoregulatory mechanism , resulting in an increase in the set point value this result agreement with Sykes, (2014); Pintore et al., (2016)Balboni et al., (2017); Hornsey et al., (2019).

The result show increase in raspatory rate (tachypnea) and heart rate in diseased dogs, , this signs may be appear due to the lesion occur in the lung and caused labored and shallow breathing and increase heart rate to response to demand the tissue for oxygen du to histotoxic hypoxia this agreement with Pereira et al., (2021); Bernardini et al., (2022), they refer to the increase the

raspatory rate and heartfct rate as a compensatory mechanism due to the decrease the totally RBCs, this lead to decrease the oxygen supply to the body tissue.

5. Conclusion

The present study of the Elisa test indicted the prevalence of the infection were higher in puppies than adult dogs, in addition to the samples were positive to antibodies against CAV1 in male higher than female in unvaccinated dogs, also the clinical signs were sever in puppies than adults dogs.

6. References

1. Alsaad, K M, E A Alsaad, and H A Al-Derawie. 2010. "Clinical and Diagnostic Study of Equine Babesiosis in Drought Horses in Some Areas of Basrah Province." *Res. J. Anim. Sci* 4 (1): 16–22.
2. Alsaad, Kamal M, Ali Jarad, and Mohanad H Lafta. 2021. "Acute Canine Babesiosis in a Dog at Basrah , Iraq (A Case Study)," no. May. https://doi.org/10.9790/2380-1405011621.
3. Balboni, A, F Dondi, C Agnoli, R Verin, M Gruarin, M Morini, and M Battilani. 2017. "Novel Sequence Variants of Viral Hexon and Fibre Genes in Two Dogs with Canine Adenovirus Type 1-Associated Disease." *The Veterinary Journal* 223: 73–75.
4. Bernardini, Angelica, Maria Irene Pacini, Niccolò Fonti, Mario Forzan, Veronica Marchetti, and Maurizio Mazzei. 2022. "Serological, Virological Investigation and Hepatic Injury Evaluation for Hepatitis E Virus in Hunting Dogs." *Pathogens* 11 (10): 1123. https://doi.org/10.3390/pathogens11101123.
5. Bulut, Oya, Orhan Yapici, Oguzhan Avci, Atilla Simsek, Kamil Atli, Irmak Dik, Sibel Yavru, Sibel Hasircioglu, Mehmet Kale, and Nuri Mamak. 2013. "The Serological and Virological Investigation of Canine Adenovirus Infection on the Dogs." *The Scientific World Journal* 2013. https://doi.org/10.1155/2013/587024.
6. Caballero-Gómez, Javier, Antonio Rivero-Juarez, Estefanía Jurado-Tarifa, Débora Jiménez-Martín, Elena Jiménez-Ruiz, Sabrina Castro-Scholten, Rainer G Ulrich, Pedro López-López, Antonio Rivero, and Ignacio García-Bocanegra. 2022. "Serological and Molecular Survey of Hepatitis E Virus in Cats and Dogs in Spain." *Transboundary and Emerging Diseases* 69 (2): 240–48.
7. Chander, Vishal, G K Sharma, Mukesh Bhatt, Sukdeb Nandi, S Mahajan, Mithilesh Singh, K Mahendran, M Karikalan, Abhijit M Pawde, and Vikas Gupta. 2021. "Isolation and Genetic Characterization of Canine Adenovirus Type 2 from a Domestic Dog Showing Neurological Symptoms." *Brazilian Journal of Microbiology* 52 (4): 2521–28.
8. Echavarría, Marcela. 2009. "Adenoviruses." *Principles and Practice of Clinical Virology*, no. Ed. 6: 463–88.
9. Ford, Richard B. 2012. "Canine Infectious Respiratory Disease." *Infectious Diseases of the Dog and Cat; Sykes, J., Greene, CE, Eds*, 55.
10. Ginsberg, Harold S. 2013. *The Adenoviruses*. Springer Science & Business Media.
11. Gür, S., and A. Acar. 2009. "A Retrospective Investigation of Canine Adenovirus (CAV) Infection in Adult Dogs in Turkey." *Journal of the South African Veterinary Association* 80 (2): 84–86. https://doi.org/10.4102/jsava.v80i2.176.

12. Headley, Selwyn A, Thalita E S Oliveira, Alfredo H T Pereira, Jéssica R Moreira, Mariana M Z Michelazzo, Bárbara G Pires, Victor Hugo B Marutani, Ana A C Xavier, Giovana W Di Santis, and João L Garcia. 2018. "Canine Morbillivirus (Canine Distemper Virus) with Concomitant Canine Adenovirus, Canine Parvovirus-2, and Neospora Caninum in Puppies: A Retrospective Immunohistochemical Study." *Scientific Reports* 8 (1): 1–16.
13. Hornsey, Samuel J., Hélène Philibert, Dale L. Godson, and Elisabeth C.R. Snead. 2019. "Canine Adenovirus Type 1 Causing Neurological Signs in a 5-Week-Old Puppy." *BMC Veterinary Research* 15 (1): 4–9. https://doi.org/10.1186/s12917-019-2173-5.
14. Jarad, Ali, and Faraj A Abed. 2020. "Clinical and Diagnostic Studies of Hemo-Mycoplasmosis in Dogs at Basrah, Iraq." *Biochemical and Cellular Archives* 20 (2): 6171–75.
15. Jonge, B. De, L. Van Brantegem, and K. Chiers. 2020. "Infectious Canine Hepatitis, Not Only in the Textbooks: A Brief Review and Three Case Reports." *Vlaams Diergeneeskundig Tijdschrift* 89 (5): 284–91. https://doi.org/10.21825/VDT.V89I5.16956.
16. Knowles, Susan, Barbara L Bodenstein, Troy Hamon, Michael W Saxton, and Jeffrey S Hall. 2018. "Infectious Canine Hepatitis in a Brown Bear (Ursus Arctos Horribilis) from Alaska, USA." *Journal of Wildlife Diseases* 54 (3): 642–45.
17. Lynch, Joseph P, Michael Fishbein, and Marcela Echavarria. 2011. "Adenovirus." In *Seminars in Respiratory and Critical Care Medicine*, 32:494–511. © Thieme Medical Publishers.
18. Mazzei, Maurizio, R Nardini, Ranieri Verin, Mario Forzan, Alessandro Poli, and Francesco Tolari. 2015. "Serologic and Molecular Survey for Hepatitis E Virus in Wild Boar (Sus Scrofa) in Central Italy." *New Microbes and New Infections* 7: 41–47.
19. Müller, C, N Sieber-Ruckstuhl, N Decaro, S Keller, S Quante, F Tschuor, M Wenger, and C Reusch. 2010. "Infectious Canine Hepatitis in 4 Dogs in Switzerland." *Schweizer Archiv Fur Tierheilkunde* 152 (2): 63–68.
20. Naji, Hussein Ali, Jihad Abdulameer Ahmed, and Kamal M Alsaad. 2018. "CHRONIC COPPER POISONING OF SHEEP AT BASRAH GOVERNORATE, IRAQ." *Basrah Journal of Veterinary Research* 17 (3).
21. Naji, Hussein Ali, Zainab Abudal Hussein Saud, Wessam Monther Mohammed Saleh, and Israa Abdul Wadoodalsaad. 2021. "Sero Prevalence of Schmallenberg Virus Antibodies in Buffalo From North Basra Governorate-Iraq." *Veterinary Practitioner* 22 (2): 14–17.
22. Naji, Hussein Ali, and Mohammad Mushgil Zenad. 2016. "Hematological and Histopathological Changes Induced by Cadmium Chloride Toxicity in Sheep, with Using Alpha Lipoic Acid as Antioxidant." *Basrah Journal of Veterinary Research* 15 (2): 83–96.
23. Pereira, Fernanda MAM, Ayisa R. de Oliveira, Elisa S. Melo, Lauro L. Soares-Neto, Danyele KA Mangueira, Daniel O. dos Santos, Thaynara P. de Carvalho, Claudia Momo, and Renato L. Santos. 2021. "Naturally Acquired Infectious Canine Hepatitis in Two Captive Maned Wolf (Chrysocyon Brachyurus) Puppies." *Journal of Comparative Pathology* 186: 62–68. https://doi.org/10.1016/j.jcpa.2021.05.006.

24. Pintore, Maria Domenica, Debora Corbellini, Maria Novella Chieppa, Elena Vallino Costassa, Caterina Lucia Florio, Katia Varello, Elena Bozzetta, et al. 2016. "Co-infezione Di Adenovirus Canino Tipo 1 e Pasteurella Pneumotropica in Un Cucciolo Di Pastore Tedesco." *Veterinaria Italiana* 52 (1): 57–62. https://doi.org/10.12834/VetIt.270.934.1.
25. Rhee, Elizabeth G, and Dan H Barouch. 2015. "145—Adenoviruses." *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 8th Edn. Content Repository Only*, 1787–93.
26. Robinson, Christine, and Marcela Echavarria. 2011. "Adenoviruses." *Manual of Clinical Microbiology*, 1600–1611.
27. Smith, Jason G, Christopher M Wiethoff, Phoebe L Stewart, and Glen R Nemerow. 2010. "Adenovirus." *Cell Entry by Non-Enveloped Viruses*, 195–224.
28. Suderman, Matthew, Mariko Moniwa, Tamiru N Alkie, Davor Ojkic, Andre Broes, Neil Pople, and Yohannes Berhane. 2021. "Comparative Susceptibility of Madin–Darby Canine Kidney (MDCK) Derived Cell Lines for Isolation of Swine Origin Influenza A Viruses from Different Clinical Specimens." *Viruses* 13 (12): 2346.
29. Sykes, Jane E. 2013. "Canine Distemper Virus Infection." *Canine and Feline Infectious Diseases. Louis: Elsevier*, 152–65.
30. ———. 2014. "Infectious Canine Hepatitis." *Canine and Feline Infectious Diseases*, 182.
31. Usman, Norina, and Manuel Suarez. 2022. "Adenoviruses." In *StatPearls [Internet]*. StatPearls Publishing.
32. Vos, A, T Müller, L Neubert, A Zurbriggen, C Botteron, D Pöhle, H Schoon, L Haas, and A C Jackson. 2004. "Rabies in Red Foxes (Vulpes Vulpes) Experimentally Infected with European Bat Lyssavirus Type 1." *Journal of Veterinary Medicine, Series B* 51 (7): 327–32.
33. Watts, Dominique E, and Anna-Marie Benson. 2016. "Prevalence of Antibodies for Selected Canine Pathogens among Wolves (Canis Lupus) from the Alaska Peninsula, USA." *Journal of Wildlife Diseases* 52 (3): 506–15.
34. Yoon, Soon-Seek, Jae-Won Byun, Young-Il Park, Min-Jeong Kim, You-Chan Bae, and Jae-Young Song. 2010. "Comparison of the Diagnostic Methods on the Canine Adenovirus Type 2 Infection." *Basic and Applied Pathology* 3 (2): 52–56.