

Taru Tikkanen ja Susanne Kilpinen

Koiran immuunivälitteinen hemolyttinen anemia - kirjallisuuskatsaus

Immune-mediated hemolytic anemia in dogs – Review

LÄHDEVIITTEET

1. Garden OA, Kidd L, Mexas AM, Chang Y, Jeffery U, Blois SL ym. ACVIM consensus statement on the diagnosis of immune-mediated hemolytic anemia in dogs and cats. *J Vet Intern Med.* 2019;33:313-34.
2. Swann JW, Garden OA, Fellman CL, Glanemann B, Goggs R, LeVine DN ym. ACVIM consensus statement on the treatment of immune-mediated hemolytic anemia in dogs. *J Vet Intern Med.* 2019;33:1141-72.
3. Mitchell K, Kruth S. Immune-mediated hemolytic anemia and other regenerative anemias. Kirjassa: Ettinger SJ, Feldman EC, Côté E, toim. *Textbook of veterinary internal medicine.* 8. painos. St. Louis: Elsevier; 2017, 761-71.
4. Friedenberg SG, Buhrman G, Chdid L, Olby NJ, Olivry T, Guillaumin J ym. Evaluation of a DLA-79 allele associated with multiple immune-mediated diseases in dogs. *Immunogenetics* 2015;68:205-17.
5. Threlfall AJ, Boag AM, Soutter F, Glanemann B, Syme HM, Catchpole B. Analysis of DLA-DQB1 and polymorphisms in CTLA4 in Cocker spaniels affected with immune-mediated haemolytic anaemia. *Canine Genet Epidemiol.* 2015;2:8.
6. Borchert C, Herman A, Roth M, Brooks AC, Friedenberg SG. RNA sequencing of whole blood in dogs with primary immune-mediated hemolytic anemia (IMHA) reveals novel insights into disease pathogenesis. *PloS One.* 2020;15:e0240975.
7. Woodward G, White J. The utility of screening diagnostic tests in identifying associative immune-mediated haemolytic anaemia in dogs. *Aust Vet J.* 2020;98:586-90.
8. Wang A, Smith JR, Creevy KE. Treatment of canine idiopathic immune-mediated haemolytic anaemia with mycophenolate mofetil and glucocorticoids: 30 cases (2007 to 2011). *J Small Anim Pract.* 2013;54:399-404.
9. Swann JW, Skelly BJ. Evaluation of immunosuppressive regimens for immune-mediated haemolytic anaemia: a retrospective study of 42 dogs. *J Small Anim Pract.* 2011;52:353-8.
10. Kozo A, Mika T, Yoichiro H, Hiroshi N, Takamasa S, Susumu M. Elevated erythrocyte-bound IgG value in dogs with clinical Babesia gibsoni infection. *J Vet Med Sci.* 1994;56:757.
11. Breitschwerdt EB, Blann KR, Stebbins ME, Munana KR, Davidson MG, Jackson HA ym. Clinicopathological abnormalities and treatment response in 24 dogs seroreactive to *Bartonella vinsonii* (berkhoffii) antigens. *J Am Anim Hosp Assoc.* 2004;40:92.
12. Quroollo BA, Buch J, Chandrashekhar R, Beall MJ, Breitschwerdt EB, Yancey CB ym. Clinicopathological findings in 41 dogs (2008-2018) naturally infected with *Ehrlichia ewingii*. *J Vet Intern Med.* 2019;33:618-29.
13. Ciaramella P, Oliva G, Luna RD, Gradoni L, Ambrosio R, Cortese L ym. A retrospective clinical study of canine leishmaniasis in 150 dogs naturally infected by *Leishmania infantum*. *Vet Rec.* 1997;141:539-43.
14. Werner LL, Halliwell R, Jackson RF, Needham TC, Limpach M. An investigation of the role of immunologic factors in anemia associated with canine heartworm disease. *Vet Immunol Immunopathol.* 1984;7:285-92.
15. Bexfield NH, Villiers EJ, Herrtage ME. Immune-mediated haemolytic anaemia and thrombocytopenia associated with *Anaplasma phagocytophilum* in a dog. *J Small Anim Pract.* 2005;46:543-8.
16. Whitney MS, Schwan TG, Sulzemeier KB, McDonald PS, Brillhart MN. Spirochetemia caused by *Borrelia turicatae* infection in 3 dogs in Texas. *Vet Clin Pathol.* 2007;36:212-6.

17. Tommaso Furlanello, Ida Reale. Leptospirosis and immune-mediated hemolytic anemia: A lethal association. *Vet Res Forum*. 2019;10:261-5.
18. Magaña A, Sánchez F, Villa K, Rivera L, Morales E. Systemic neosporosis in a dog treated for immune-mediated thrombocytopenia and hemolytic anemia. *Vet Clin Pathol*. 2015;44:592-6.
19. Fernandez Y, Sharman MJ, Seth M. Pregnancy-associated immune-mediated hemolytic anemia in a dog. *J Vet Emerg Crit Care*. 2020;30:308-11.
20. Warman SM, Murray JK, Ridyard A, Eastwood J, Silva S, Day MJ. Pattern of Coombs' test reactivity has diagnostic significance in dogs with immune-mediated haemolytic anaemia. *J Small Anim Pract*. 2008;49:525-30.
21. Weinkle TK, Center SA, Randolph JF, Warner KL, Barr SC, Erb HN. Evaluation of prognostic factors, survival rates, and treatment protocols for immune-mediated hemolytic anemia in dogs: 151 cases (1993-2002). *J Am Vet Med Assoc*. 2005;226:1869-80.
22. Goggs R, Boag AK, Chan DL. Concurrent immune-mediated haemolytic anaemia and severe thrombocytopenia in 21 dogs. *Vet Rec*. 2008;163:323-7.
23. Duval D, Giger U. Vaccine-associated immune-mediated hemolytic anemia in the Dog. *J Vet Intern Med*. 1996;10:290-5.
24. Catharine J, Scott_Moncrieff R. Immune-mediated disorders. Kirjassa: Nelson RW, Couto CG, toim. Small Animal Internal Medicine. 6. painos. St. Louis: Elsevier; 2020, 1283-440.
25. Helmond SE, Polzin DJ, Armstrong PJ, Finke M, Smith SA. Treatment of immune-mediated hemolytic anemia with individually adjusted heparin dosing in dogs. *J Vet Intern Med*. 2010;24:597-605.
26. Mackman N. New insights into the mechanisms of venous thrombosis. *J Clin Invest*. 2012;122:2331-6.
27. Weingart C, Thielemann D, Kohn B. Primary immune-mediated haemolytic anaemia: a retrospective long-term study in 61 dogs. *Aust Vet J*. 2019;97:483-9.
28. Assenmacher TD, Jutkowitz LA, Koenigshof AM, de A Lucidi C, Scott MA. Clinical features of precursor-targeted immune-mediated anemia in dogs: 66 cases (2004-2013). *J Am Vet Med Assoc*. 2019;255:366-76.
29. McAlees TJ. Immune-mediated haemolytic anaemia in 110 dogs in Victoria, Australia. *Aust Vet J*. 2010;88:25-8.
30. Miller SA, Hohenhaus AE, Hale AS. Case-control study of blood type, breed, sex, and bacteremia in dogs with immune-mediated hemolytic anemia. *J Am Vet Med Assoc*. 2004;224:232-5.
31. Piek CJ, Junius G, Dekker A, Schrauwen E, Slappendel RJ, Teske E. Idiopathic immune-mediated hemolytic anemia: treatment outcome and prognostic factors in 149 dogs. *J Vet Intern Med*. 2008;22:366-73.
32. Zandecki M, Genevieve F, Gerard J, Godon A. Spurious counts and spurious results on haematology analysers: a review. Part II: white blood cells, red blood cells, haemoglobin, red cell indices and reticulocytes. *Int J Lab Hematol*. 2007;29:21-41.
33. Griebsch C, Arndt G, Raila J, Schweigert FJ, Kohn B. C-reactive protein concentration in dogs with primary immune-mediated hemolytic anemia. *Vet Clin Path*. 2009;38:421-5.
34. Slappendel RJ, van Zwieten R, van Leeuwen M, Schneijdenberg CT. Hereditary spectrin deficiency in golden retriever dogs. *J Vet Intern Med*. 2005;19:187.
35. MacNeill AL, Dandrieux J, Lubas G, Seelig D, Szladovits B. The utility of diagnostic tests for immune-mediated hemolytic anemia. *Vet Clin Path*. 2019;48:7-16.
36. Sun PL, Jeffery U. Effect of dilution of canine blood samples on the specificity of saline agglutination tests for immune-mediated hemolysis. *J Vet Intern Med*. 2020;34:2374-83.
37. Paes G, Paepe D, Meyer E, Kristensen AT, Duchateau L, Campos M ym. The use of the rapid osmotic fragility test as an additional test to diagnose canine immune-mediated haemolytic anaemia. *Acta Vet Scand*. 2013;55:74.
38. Wardrop KJ. Coombs' testing and its diagnostic significance in dogs and cats. *Vet Clin North Am Small Anim Pract*. 2012;42:43-51.
39. Quigley KA, Chelack BJ, Haines DM, Jackson ML. Application of a direct flow cytometric erythrocyte immunofluorescence assay in dogs with immune-mediated hemolytic anemia and comparison to the direct antiglobulin test. *J Vet Diagn Invest*. 2001;13:297-300.

40. Overmann JA, Sharkey LC, Weiss DJ, Borjesson DL. Performance of 2 microtiter canine Coombs' tests. *Vet Clin Path*. 2007;36:179-83.
41. Caviezel LL, Raj K, Giger U. Comparison of 4 direct Coombs' test methods with polyclonal antiglobulins in anemic and nonanemic dogs for in-clinic or laboratory use. *J Vet Intern Med*. 2014;28:583-91.
42. Andres M, Hostnik E, Green E, Langston C, Parker VJ, Gilor C ym. Diagnostic utility of thoracic radiographs and abdominal ultrasound in canine immune-mediated hemolytic anemia. *Can Vet J*. 2019;60:1065-71.
43. Goggs R. Therapeutic strategies for treatment of immune-mediated hemolytic anemia. *Vet Clin North Am Small Anim Pract*. 2020;50:1327-49.
44. Kisielewicz C, Self IA. Canine and feline blood transfusions: controversies and recent advances in administration practices. *Vet Anaesth Analg*. 2014;41:233-42.
45. Hann L, Brown DC, King LG, Callan MB. Effect of duration of packed red blood cell storage on morbidity and mortality in dogs after transfusion: 3,095 cases (2001-2010). *J Vet Intern Med*. 2014;28:1830-7.
46. Swann JW, Skelly BJ. Systematic review of prognostic factors for mortality in dogs with immune-mediated hemolytic anemia. *J Vet Intern Med*. 2015;29:7-13.
47. Sato M, Veir JK, Legare M, Lappin MR. A retrospective study on the safety and efficacy of leflunomide in dogs. *J Vet Intern Med*. 2017;31:1502-7.
48. Gregory CR, Kyles AE, Bernsteen L, Mehl M. Results of clinical renal transplantation in 15 dogs using triple drug immunosuppressive therapy. *Vet Surg*. 2006;35:105-12.
49. Goggs R, Blais M, Brainard BM, Chan DL, deLaforcade AM, Rozanski E ym. American College of Veterinary Emergency and Critical Care (ACVECC) consensus on the rational use of antithrombotics in veterinary critical care (CURATIVE) guidelines: Small animal. *J Vet Emerg Crit Care*. 2019;29:12-36.
50. Panek CM, Nakamura RK, Bianco D. Use of enoxaparin in dogs with primary immune-mediated hemolytic anemia: 21 cases. *J Vet Emerg Crit Care*. 2015;25:273-7.
51. Thompson MF, Scott-Moncrieff JC, Brooks MB. Effect of a single plasma transfusion on thromboembolism in 13 dogs with primary immune-mediated hemolytic snemia. *J Am Anim Hosp Assoc*. 2004;40:446-54.
52. Uchida M, Ohmi A, Fujiwara R, Fukushima K, Doi A, Azuma K ym. Treatment with rivaroxaban and monitoring of coagulation profiles in two dogs with venous thromboembolism. *J Vet Med Sci*. 2020;82:1271-6.
53. Morassi A, Bianco D, Park E, Nakamura RK, White GA. Evaluation of the safety and tolerability of rivaroxaban in dogs with presumed primary immune-mediated hemolytic anemia. *J Vet Emerg Crit Care*. 2016;26:488-94.
54. Evans LA, Tansey C, Wiebe M, Sloan CQ, Patlogar JE, Northcutt S ym. A prospective evaluation of rivaroxaban on haemostatic parameters in apparently healthy dogs. *Vet Med Sci*. 2019;5:317-24.
55. Lynch AM, Ruterbories LK, Griffith EH, Hanel RM, Stablein AP, Brooks MB. Evaluation of point-of-care coagulation tests as alternatives to anti-Xa activity for monitoring the anticoagulant effects of rivaroxaban in healthy dogs. *J Vet Emerg Crit Care*. 2021;31:18-24.
56. Brainard BM, Kleine SA, Papich MG, Budsberg SC. Pharmacodynamic and pharmacokinetic evaluation of clopidogrel and the carboxylic acid metabolite SR 26334 in healthy dogs. *Am J Anim Vet Sci*. 2010;71:822-30.
57. Dudley A, Thomason J, Fritz S, Grady J, Stokes J, Wills R ym. Cyclooxygenase expression and platelet function in healthy dogs receiving low-dose aspirin. *J Vet Intern Med*. 2013;27:141-9.
58. Marks SL, Kook PH, Papich MG, Tolbert MK, Willard MD. ACVIM consensus statement: Support for rational administration of gastrointestinal protectants to dogs and cats. *J Vet Intern Med*. 2018;32:1823-40.
59. Tolbert K, Bissett S, King A, Davidson G, Papich M, Peters E ym. Efficacy of oral famotidine and 2 omeprazole formulations for the control of intragastric pH in dogs. *J Vet Intern Med*. 2011;25:47-54.

60. Whelan MF, O'Toole TE, Chan DL, Rozanski EA, DeLaforcade AM, Crawford SL ym. Use of human immunoglobulin in addition to glucocorticoids for the initial treatment of dogs with immune-mediated hemolytic anemia. *J Vet Emerg Crit Care* 2009;19:158-64.
61. Park S, Kim H, Kang B, Kang J, Yang M. Prognostic factors and efficacy of human intravenous immunoglobulin G in dogs with idiopathic immune-mediated hemolytic anemia: a retrospective study. *Korean J Vet Res.* 2016;56:139-45.
62. Whelan MF, O'Toole TE, Chan DL, Rozanski EA, DeLaforcade AM, Crawford SL ym. Use of human immunoglobulin in addition to glucocorticoids for the initial treatment of dogs with immune-mediated hemolytic anemia. *J Vet Emerg Crit Care* 2009;19:158-64.
63. Gerber B, Steger A, Hässig M, Glaus TM. Use of human intravenous immunoglobulin in dogs with primary immune mediated hemolytic anemia. *Schweiz Arch Tierheilkd.* 2002;144:180-5.
64. Oggier D, Tomsa K, Mevissen M, Glaus T. Efficacy of the combination of glucocorticoids, mycophenolate-mofetil and human immunoglobulin for the therapy of immune mediated haemolytic anaemia in dogs. *Schweiz Arch Tierheilkd.* 2018;160:171-8.
65. Horgan JE, Roberts BK, Schermerhorn T. Splenectomy as an adjunctive treatment for dogs with immune-mediated hemolytic anemia: ten cases (2003–2006). *J Vet Emerg Crit Care* 2009;19:254-61.
66. Francey T, Etter M, Schweighauser A. Evaluation of membrane-based therapeutic plasma exchange as adjunctive treatment for immune-mediated hematologic disorders in dogs. *J Vet Intern Med.* 2021;35:925-35.
67. Heffner GG, Cavanagh A, Nolan B. Successful management of acute bilirubin encephalopathy in a dog with immune-mediated hemolytic anemia using therapeutic plasma exchange. *J Vet Emerg Crit Care* 2019;29:549-57.
68. Scagnelli AM, Walton SA, Liu C, Acierno MJ. Effects of therapeutic plasma exchange on serum immunoglobulin concentrations in a dog with refractory immune-mediated hemolytic anemia. *J Am Vet Med Assoc.* 2018;252:1108-12.
69. Swann JW, Garden OA. Novel immunotherapies for immune-mediated haemolytic anaemia in dogs and people. *Vet J.* 2016;207:13-9.
70. Plumb DC. Plumb's veterinary drug handbook. 9. painos. Tukholma: PharmaVet Inc; 2018.