

Molecular Identification of *Bartonella* Species in Dogs and Arthropod Vectors in Hamedan and Kermanshah, Iran

Zahra Shamshiri¹, Ali Goudarztalejerdi^{2*}, Seyed Massoud Zolhavarieh³,
Mohammad Kamalpour⁴ and Alireza Sazmand¹

¹ MSc of Bacteriology, Department of Pathobiology, Faculty of Veterinary Science, Bu-Ali Sina University, Hamedan, Iran

² Assistant Professor, Department of Pathobiology, Faculty of Veterinary Science, Bu-Ali Sina University, Hamedan, Iran

³ Assistant Professor, Department of Clinical Sciences, Faculty of Veterinary Science, Bu-Ali Sina University, Hamedan, Iran

⁴ Assistant Professor, Department of Basic Science, School of Veterinary Medicine, Lorestan University, Khorramabad, Iran

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Abstract

Bartonella species are lesser-known pathogenic bacteria that infect a wide range of domestic and wild animals as well as humans. Currently, out of 40 *Bartonella* species/subspecies, at least 17 are associated with clinical signs in humans and animals. However, despite the zoonotic importance of bartonellosis, there is limited information about prevalence and species infecting dogs and cats in Iran. The aim of this study was molecular identification of *Bartonella* species in dogs and arthropods infesting them in Hamedan and Kermanshah cities in the west of Iran. Blood genomic DNA (gDNA) was extracted from 100 dogs (45 from Hamedan and 55 from Kermanshah) and, of 25 *Ctenocephalides canis* fleas, six *Pulex irritans* fleas and 12 *Rhipicephalus sanguineus* ticks collected from nine infested dogs were examined for the presence of *Bartonella* species. Conventional PCR targeting fragments of ITS and *rpoB* genes was performed, and PCR-positive samples were sequenced bidirectionally and analyzed phylogenetically. Out of 100 dogs, 14 dogs (14%, ten from Hamedan and four from Kermanshah) were found infected with *Bartonella* species. Nucleotide sequencing confirmed the presence of four *Bartonella* species in the examined population i.e. *Bartonella vinsonii* subsp. *berkhoffii* and *Candidatus* *B. merieuxii* in dogs. None of the examined fleas scored positive but one *Rh. sanguineus* tick from a blood-negative dog was infected with *Bartonella* DNA. Results of the present study showed the presence of different zoonotic *Bartonella* species in dogs of Hamedan and Kermanshah cities highlighting the importance of this vector-borne infection. Effective ectoparasite control strategies, regular examination of pet and urban dogs and cats and successful chemoprophylaxis are suggested.

Key words: Arthropods, *Bartonella*, Dogs, Hamedan, Kermanshah, PCR, Zoonotic

* **Corresponding Author:** Ali Goudarztalejerdi, Assistant Professor, Department of Pathobiology, Faculty of Veterinary Science, Bu-Ali Sina University, Hamedan, Iran
E-mail: a.goudarz@basu.ac.ir



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References

- Abdullah, S., Helps, C., Tasker, S., Newbury, H., & Wall, R. (2019). Pathogens in fleas collected from cats and dogs: distribution and prevalence in the UK. *Parasites & Vectors*, *12*(1), 71.
- Alanazi, A. D., Alouffi, A. S., Alyousif, M. S., Alshahrani, M. Y., Abdullah, H., Abdel-Shafy, S., Calvani, N.E.D., Ansari-Lari, M., Sazmand, A., & Otranto, D. (2020). Molecular survey of vector-borne pathogens of dogs and cats in two regions of Saudi Arabia. *Pathogens*, *10*(1).
- Alvarez-Fernandez, A., Breitschwerdt, E. B., & Solano-Gallego, L. (2018). *Bartonella* infections in cats and dogs including zoonotic aspects. *Parasites & Vectors*, *11*(1), 624.
- Bahari, A., Azami, S., Goudarztalejardi, A., Karimi, S., Esmaeili, S., Chomel, B. B., & Sazmand, A. (2021). molecular detection of zoonotic pathogens in the blood and tissues of camels (*Camelus dromedarius*) in central desert of Iran. *Yale Journal of Biology and Medicine*, *94*(2), 249-258.
- Belkhiria, J., Chomel, B. B., Ben Hamida, T., Kasten, R. W., Stuckey, M. J., Fleischman, D. A., Christopher, M.M., Boulouis, H.J., & Farver, T. B. (2017). Prevalence and potential risk factors for *Bartonella* infection in Tunisian stray dogs. *Vector Borne Zoonotic Disease*, *17*(6), 388-397.
- Billeter, S. A., Kasten, R. W., Killmaster, L. F., Breitschwerdt, E. B., Levin, M. L., Levy, M. G., Kosoy, M.Y., & Chomel, B. B. (2012). Experimental infection by capillary tube feeding of *Rhipicephalus sanguineus* with *Bartonella vinsonii* subspecies *berkhoffii*. *Comparative Immunology, Microbiology & Infectious Diseases*, *35*(1), 9-15.
- Billeter, S. A., Levy, M. G., Chomel, B. B., & Breitschwerdt, E. B. (2008). Vector transmission of *Bartonella* species with emphasis on the potential for tick transmission. *Medical and Veterinary Entomology*, *22*(1), 1-15.
- Breitschwerdt, E. B., Kordick, D. L., Malarkey, D. E., Keene, B., Hadfield, T. L., & Wilson, K. (1995). Endocarditis in a dog due to infection with a novel *Bartonella* subspecies. *Journal of Clinical Microbiology*, *33*(1), 154-160.
- Cannon, S. H., Levy, J. K., Kirk, S. K., Crawford, P. C., Leutenegger, C. M., Shuster, J. J., Liu, J., & Chandrashekar, R. (2016). Infectious diseases in dogs rescued during dogfighting investigations. *Veterinary journal*, *211*, 64-69.
- Celebi, B., Carhan, A., Kilic, S., & Babur, C. (2010). Detection and genetic diversity of *Bartonella vinsonii* subsp. *berkhoffii* strains isolated from dogs in Ankara, Turkey. *Journal of Veterinary Medical Science*, *72*(8), 969-973.
- Chekli, Z., Haddad, N., Mellouki, F., Rhallabi, N., & Boulouis, H. J. (2020). First molecular detection of *Bartonella* spp. in stray cats and dogs in Morocco. *International Journal of Infectious Diseases*, *101*, 543.
- Chomel, B. B., Boulouis, H. J., Breitschwerdt, E. B., Kasten, R. W., Vayssier-Taussat, M., Birtles, R. J., Koehler, J.E., & Dehio, C. (2009). Ecological fitness and strategies of adaptation of *Bartonella* species to their hosts and vectors. *Veterinary Research*, *40*(2), 29.
- Chomel, B. B., Boulouis, H. J., Maruyama, S., & Breitschwerdt, E. B. (2006). *Bartonella* spp. in pets and effect on human health. *Emerging Infectious Diseases*, *12*(3), 389-394.
- Chomel, B. B., McMillan-Cole, A. C., Kasten, R. W., Stuckey, M. J., Sato, S., Maruyama, S., Diniz, P.P., & Breitschwerdt, E. B. (2012). *Candidatus Bartonella merieuxii*, a potential new zoonotic *Bartonella* species in canids from Iraq. *PLoS Neglected Tropical Diseases*, *6*(9), e1843-e1843.
- Diniz, P. P., Maggi, R. G., Schwartz, D. S., Cadenas, M. B., Bradley, J. M., Hegarty, B., & Breitschwerdt, E. B. (2007). Canine bartonellosis: serological and molecular prevalence in Brazil and evidence of co-infection with *Bartonella henselae* and *Bartonella vinsonii* subsp. *berkhoffii*. *Veterinary Research*, *38*(5), 697-710.
- Foley, J. E., Brown, R. N., Gabriel, M. W., Henn, J., Drazenovich, N., Kasten, R., Green, S.L., & Chomel, B. B. (2007). Spatial analysis of the exposure of dogs in rural north-coastal California to vectorborne pathogens. *Veterinary Record*, *161*(19), 653-657.
- Ghaemi, M., Sharifiyazdi, H., Heidari, F., Nazifi, S., & Ghane, M. (2019). '*Candidatus Bartonella dromedarii*' in the dromedary camels of Iran: Molecular investigation, phylogenetic analysis, hematological findings, and acute-phase proteins quantitation. *Veterinary Microbiology*, *237*, 108404.
- Greco, G., Sazmand, A., Goudarztalejardi, A., Zolhavarieh, S. M., Decaro, N., Lapsley, W. D., Otranto, D., & Chomel, B. B. (2019). High prevalence of *Bartonella* sp. in dogs from Hamadan, Iran. *American Journal of Tropical Medicine and Hygiene*, *101*(4), 749-752.

- Greco, G., Zarea, A. A. K., Sgroi, G., Tempesta, M., D'Alessio, N., Lanave, G., Bezerra-Santos, M.A., Iatta, R., Veneziano, V., Otranto, D., & Chomel, B. (2021). Zoonotic *Bartonella* species in Eurasian wolves and other free-ranging wild mammals from Italy. *Zoonoses and Public Health*, 68(4), 316-326.
- Henn, J. B., Gabriel, M. W., Kasten, R. W., Brown, R. N., Theis, J. H., Foley, J. E., & Chomel, B. B. (2007). Gray foxes (*Urocyon cinereoargenteus*) as a potential reservoir of a *Bartonella clarridgeiae*-like bacterium and domestic dogs as part of a sentinel system for surveillance of zoonotic arthropod-borne pathogens in northern California. *Journal of Clinical Microbiology*, 45(8), 2411-2418.
- Hermanson, J., & de Lahunta, A. (2020). Miller and Evan's anatomy of the dog, p. 2119. Elsevier, St. Louis, Mo.
- Kaewmongkol, G., Kaewmongkol, S., Burmej, H., Bennett, M. D., Fleming, P. A., Adams, P. J., Wayne, A.F., Ryan, U., Irwin, P.J., & Fenwick, S. G. (2011). Diversity of *Bartonella* species detected in arthropod vectors from animals in Australia. *Comparative Immunology, Microbiology & Infectious Diseases*, 34(5), 411-417.
- Kordick, D. L., & Breitschwerdt, E. B. (1998). Persistent infection of pets within a household with three *Bartonella* species. *Emerging Infectious Diseases*, 4(2), 325-328.
- Laidoudi, Y., Bedjaoui, S., Medkour, H., Latrofa, M. S., Mekroud, A., Bitam, I., Davoust, B., Otranto, D., & Mediannikov, O. (2020). Molecular approach for the diagnosis of blood and skin canine filarioids. *Microorganisms*, 8(11).
- Mazaheri Nezhad Fard, R., Vahedi, S. M., Ashrafi, I., Alipour, F., Sharafi, G., Akbarein, H., & Aldavood, S. J. (2016). Molecular identification and phylogenetic analysis of *Bartonella henselae* isolated from Iranian cats based on *gltA* gene. *Veterinary Research Forum*, 7(1), 69-72.
- Oskoeizadeh, K., Salehi, T. Z., Aldavood, S. J., Majlesi, B., Ghaffari, H., Tamami, I. A., & Aliyari, A. (2008). Study in prevalence of *Bartonella henselae* infection in domestic cats from Tehran. *Journal of Veterinary Research*, 63(3), 183-189.
- Oskouizadeh, K., Mosallanejad, B., Shapouri, M. R. S. A., & Sanaei, K. (2013). A cross sectional study on *Bartonella henselae* infection in dogs in Ahvaz district by PCR. *Iranian Veterinary Journal*, 9(3), 5-12.
- Oskouizadeh, K., Zahraei-Salehi, T., & Aledavood, S. (2010). Detection of *Bartonella henselae* in domestic cats' saliva. *Iranian Journal of Microbiology*, 2(2), 80-84.
- Renesto, P., Gouvernet, J., Drancourt, M., Roux, V., & Raoult, D. (2001). Use of *rpoB* gene analysis for detection and identification of *Bartonella* species. *Journal of Clinical Microbiology*, 39(2), 430-437.
- Roux, V., Eykyn, S. J., Wyllie, S., & Raoult, D. (2000). *Bartonella vinsonii* subsp. *berkhoffii* as an agent of afebrile blood culture-negative endocarditis in a human. *Journal of Clinical Microbiology*, 38(4), 1698-1700.
- Saengsawang, P., Kaewmongkol, G., Phoosangwalthong, P., Chimnoi, W., & Inpankaew, T. (2021). Detection of zoonotic *Bartonella* species in ticks and fleas parasitizing free-ranging cats and dogs residing in temples of Bangkok, Thailand. *Veterinary Parasitology: Regional Studies and Reports*, 25, 100612.
- Samsami, S., Ghaemi, M., & Sharifiyazdi, H. (2020). Molecular detection and phylogenetic analysis of '*Candidatus Bartonella merieuxii*' in dogs and its effect on hematologic parameters. *Comparative Immunology, Microbiology & Infectious Diseases*, 72, 101504.
- Satta, G., Chisu, V., Cabras, P., Fois, F., & Masala, G. (2011). Pathogens and symbionts in ticks: a survey on tick species distribution and presence of tick-transmitted micro-organisms in Sardinia, Italy. *Journal of Medical Microbiology*, 60, 63-68.
- Sazmand, A., Harl, J., Eigner, B., Hodžić, A., Beck, R., Hekmatimoghaddam, S., S., Mirzaei, M., Fuehrer, H.P., & Joachim, A. (2019). Vector-borne bacteria in blood of camels in Iran: New data and literature review. *Comparative Immunology, Microbiology & Infectious Diseases*, 65, 48-53.
- Seo, J.-W., Kim, C.-M., Yun, N. R., Kim, D.-M., Kim, S. S., Choi, S., & Chu, H. (2020). Scalp eschar and neck lymphadenopathy after tick bite (SENLAT) caused by *Bartonella henselae* in Korea: a case report. *BMC Infectious Diseases*, 20(1), 216.
- Shoorijeh, S. J., Ghasrodashti, A. R., Tamadon, A., Moghaddar, N., & Behzadi, M. A. (2008). Seasonal frequency of ectoparasite infestation in dogs from Shiraz, southern Iran. *Turkish Journal of Veterinary & Animal Sciences*, 32, 309-313.
- Taylor, M. A., Coop, R. L., & Wall, R. L. (2015). *Veterinary parasitology*, 4th Edition, p. 259-312. Wiley Blackwell, Oxford; Ames, Iowa.

- Tamura, K., Stecher, G., Peterson, D., FilipSKI, A., & Kumar, S. (2013). MEGA6: Molecular Evolutionary Genetics Analysis version 6.0. *Molecular Biology and Evolution*, 30(12), 2725-2729.
- Tsai, Y. L., Lin, C. C., Chomel, B. B., Chuang, S. T., Tsai, K. H., Wu, W. J., Huang, C.G., Yu, J.C., Sung, M.H., Kass, P.H., & Chang, C. C. (2011). *Bartonella* infection in shelter cats and dogs and their ectoparasites. *Vector Borne Zoonotic Disease*, 11(8), 1023-1030.
- WikswO, M. E., Hu, R., Metzger, M. E., & Eremeeva, M. E. (2007). Detection of *Rickettsia rickettsii* and *Bartonella henselae* in *Rhipicephalus sanguineus* ticks from California. *Journal of Medical Entomology*, 44(1), 158-162.
- Zouari, S., Khrouf, F., M'ghirbi, Y., & Bouattour, A. (2017). First molecular detection and characterization of zoonotic *Bartonella* species in fleas infesting domestic animals in Tunisia. *Parasites & Vectors*, 10(1), 436.