Journal of Animal Health and Behavioural Science

Upadhyay et al., J Anim Health Behav Sci, an open access journal 2018, 2:1

Mini Review Open Access

Vector-Borne Zoonotic Diseases

Upadhyay AK*, Maansi, Parmar T, Singh P and Pathak AP

College of Veterinary and Animal Sciences, G B Pant University of Agriculture and Technology, India

***Corresponding author:** Ajay Kumar Upadhyay, Veterinary Public Health and Epidemiology, College of Veterinary and Animal Sciences, G B Pant University of Agriculture and Technology, Pantnagar, India, Tel: 9411195407; E-mail: ajay.akup@gmail.com

Received date: January 08, 2018; **Accepted date:** January 18, 2018; **Published date:** January 25, 2018

Abstract

Canine vector-borne diseases have emerged as one of the most prevalent global infestations globally in recent years. However, the absences of these parasites in any area may be due to diagnostic incapability. There are insufficiencies of systematic studies into vector-borne zoonotic infections in India due to lack of diagnostic zeal in clinicians as well as laboratory associated staff. Diagnosis is mainly dependent on traditional methods using microscopic observation of organisms in stained smears. Serological approaches have their own limitations because sometimes species-specific diagnosis is mandatory. Moreover, serological tests have all the possibility of false positive and false negative results that confound interpretation. Molecular tools based diagnostic tests are costly and requires skilled personnel to carry out. Therefore, a holistic approach is necessary for comprehensive diagnosis to chalk out strategies of treatment and prevention of further spread. Above and beyond, even if the hurdle of diagnosis are met, there is a lack of availability of effective treatment as well as robust surveillance strategies that make it difficult to maintain, making it hard for containment.

Keywords: Animal; Human; Vector; Zoonoses

Introduction

Vector-borne diseases cause a diversified group of illnesses. Proper management of these diseases is important because these pathogens are transmissible to humans and animals, which often live in close proximity [1-4]. Arthropod vectors cause a great deal of annoyance. More than just irritation by piercing, they can inoculate pathogenic microorganisms such as viruses, bacteria, protozoa, and helminthes. Various members of the phylum Arthropoda, such as ticks, mosquitoes, sand flies, kissing bugs, fleas, and lice are efficient vectors of important pathogenic organisms to animals and humans. The global burden of diseases such as Babesia, Malaria, Hepatozoonosis, Anaplasma and Ehrlichia disease is immense [5]. Reservoir hosts of these pathogens include wildlife, livestock, and companion animals causing disease in humans [6]. Although, the role of animals as reservoirs for some of these pathogens is not well explicated even though, the control of vector-borne diseases is extremely desirable and discussed briefly hereunder.

Hepatozoonosis

Vector borne zoonosis transferred by canines varies from subclinical infections of *Hepatozoon canis* to severe and grave diseases caused by *Hepatozoon americanum*. Canine hepatozoonosis caused by *H. canis* has been reported most frequently as a subclinical infection in the north-west region of India; with prevalence ranging from 3% to 9% in Punjab. In many parts of the world, concurrent infection of *H. canis* with other infectious agents such as Ehrlichia, Leishmania and parvovirus is common. *H. canis* in dogs occurs by ingestion of an infected tick, *R. sanguine* [7].

Anaplasmosis

Canine anaplasmosis occurs due to intracellular rickettsial organisms of the genus Anaplasma that may also occur in human. Two species of this parasite are well-known to be pathogenic in dogs. *Anaplasma platys* is the causes of canine infectious cyclic thrombocytopenia. Moreover, *Anaplasma phagocytophilum* parasitizes neutrophils, is zoonotic, and causes granulocytic anaplasmosis in numerous countries of the northern hemisphere. Single infections with *A. platys* are generally clinically unapparent but pathogenicity enhances with concurrent infections [8].

Babesiosis

Babesiosis is an important disease, but the epidemiology of canine babesiosis has been inadequately investigated. In a large study conducted in 2016, the prevalence rate of *B. bigemina* was 22.83% from in Gujarat [9], 0.25% to 8.33% was reported from Punjab [10], 0.6 to 16% from Karnataka [3] and 1.3% from Maharastra [11]. In addition, it has strong possibility that both *Babesia vogeli* and *B. gibsoni* may be co-endemic in India with ticks *Rhipicephalus sanguineus* and *Haemaphysalis longicornis* being putative vectors, respectively.

Ehrlichia

Ehrlichia is considered as an alpha-proteobacterium of belonging to the family Anaplasmataceae. Species that are able to produce infection in dogs are *Ehrlichia canis* (tropical canine pancytopenia), *Ehrlichia ewingii* (canine granulocytic ehrlichiosis) and *Ehrlichia chaffeensis*. The few studies investigating the prevalence of canine Ehrlichiosis in India using conventional examination of stained blood smears have reported prevalence in dog as 18.9% in Nagpur, 1.35% in Punjab, 55% in Maharashtra and 46.9% in Chennai positive for *Ehrlichia* spp. [12].

Ticks

In a significant study that observed the occurrences of both ticks and tick borne diseases in dogs found them made known to be higher in Delhi and Mumbai compared to Ladakh and Sikkim, probably due to diverse climates. They also observed that the genus Rhipicephalus was more prevalent followed by Haemaphysalis. Furthermore, Haemaphysalis ticks were identified only in Sikkim. Haemaphysalis ticks have been reported previously in the rural highland areas of India such as Jammu Kashmir, Himachal Pradesh and Arunachal Pradesh, and a study in Japan also revealed that dogs in rural areas carried more Haemaphysalis ticks. In contrast Rhipicephalus is often associated with dogs in urban areas [13].

Management Strategies

In recent times, isoxazoline class molecules (e.g., fluralaner, afoxolaner, sarolaner and lotilaner) have been successfully introduced in the market as systemic ectoparasiticides for oral or topical use with a fast/selective parasiticidal activity [14]. These molecules display a fairly rapid onset of action, starting from 4 hours and reaching>90% of their killing effect in about 12 hours [15]. The persistent efficacy of isoxazolines against ticks is from 4 weeks up to 12 weeks for most of the ticks including, *Dermacentor reticulatus*, *Ixodes ricinus*, *Ixodes hexagonus* and *Rh. sanguineus* under field conditions.

Formulations containing insect growth regulators such as lufenuron or juvenile hormone analogues such as methoprene and pyriproxyfen are available for flea control on dogs. These compounds have the property to prevent eggs from hatching as well as to kill larvae or early pupae [16]. In flea control, prevention of the environmental contamination by eggs, larvae and pupae is an important step; which may be achieved by inhibiting egg production if flea blood feeding is blocked within 24 hours [17]. A few strategies are discussed.

Once-a-month topical

Once-a-month topical insecticides are available that are applied to a small area on the back of the dog, are probably the easiest product to use, and generally, last the longest. Some of them can kill fleas and ticks, and others just fleas. Common once-a-month topical insecticides are permethrin, pyrethrin, imidacloprid and fipronil.

Sprays

Flea and tick control sprays are available as aerosols or pump bottles. These sprays often contain permethrin or pyrethrin. The spray should be applied in a well-ventilated area and a small cotton ball must be affixed around the eyes and ears of muzzled dog. Some dogs do not allow to be sprayed; in that case cloth immersed in medicine may be rubbed over the affected part of dog.

Powders

Powders are generally easy to apply but can be create an untidiness. Powders may not be the best choice of product because they could be inhaled and therefore; it must be avoided in asthmatic dogs. Be sure to use powders in well-ventilated areas. Powders often contain pyrethrin.

Dips

Dips and rinses are applied to the entire animal, and there are always possibilities of some residual activity. They should be applied in a well-ventilated area and it is always helpful to place cotton balls in the dog's ears and ophthalmic ointment in the dog's eyes. Even with these precautions, one should be very careful not to get any of the products in the dog's ears or eyes. Dips and rinses usually contain permethrin, pyrethrin and amitraz.

Shampoos

To properly use a flea and tick shampoo, it must be applied over the entire body and left for 10 minutes before rinsing it off. Shampoos help to primarily rid of the dog of the ticks already present on its body. Precautions must be taken to protect the eyes and ears of the dog. Shampoos often contain pyrethrin.

Collars

Collars must be applied properly by suitably inserting two fingers between the collar and the neck of dog. The excess portion of the collar should be cut off after applying at right place to avoid chewing by other dogs. Careful attention should be given for symptoms of any irritation under the collar. If this occurs, a different product must be used.

Tick control in the outdoor environment generally involves eliminating the habitat in the yard and kennel areas where ticks are most likely to occur. Ticks tend to prefer tall grasses and bushes from which they can more easily get onto an animal. To help prevent tick exposure, try to keep your dog from entering bushes and tall grass patches.

Mosquito control

Mosquitoes also transmit several diseases. The use of mosquito repellents in homes and outside is desirable as an effective control programme. Mosquito control using biological agents and genetic engineering has been carried out tried in some countries. In some situations, chemical control remains the most important and, eventually, the only option for the control of several vectors and preventing vector-borne diseases [18]. Conversely, reducing exposure to vector bites can minimize the risk of infection and the only way to achieve this is by using repellents and fast-killing ectoparasiticides.

Vaccines

Several tick antigens have been effective in vaccine formulations to reduce tick infestations in domestic animals. Vaccines have been effective in reducing tick populations for one-host tick species such as *Rhipicephalus spp.* infecting cattle and acting as vectors of the highly economically relevant, bovine anaplasmosis and bovine babesiosis [19]. However, the challenge is to produce cost-effective vaccine formulations with longwith a long lasting, protective immune response, easy to administer, and with high efficacy on reducing tick infestations and attachment. For bovine anaplasmosis, which is also transmitted by biting insects and blood-contaminated fomites [20] vaccines would be more effective for disease control.

Vaccines designed to protect humans need to show high efficacy in reducing tick attachment, and feeding time, and decreased host infection. The use of inactivated and recombinant *B. burgdorferi* outer surface proteins increases the efficacy of [21]. Vaccines with high efficacy on affecting tick attachment and feeding time will also contribute to reducing the risk for tick-borne anaphylactic reactions.

Conclusion

Vector-borne diseases are multifactorial diseases. As such, a multifaceted, holistic approach is required to address all determinants involved in the health-disease process, which often act synergistically. Nonetheless, simple measures, such as immediate tick removal, can reduce considerably the risk of exposure to tick-borne pathogens in dogs and humans [22,23], even though veterinarians and physicians do not always emphasize this method of disease prevention.

In such an approach, veterinarians have an essential role in educating dog owners regarding the best evidence-based practices for vector control. While dog owners living in remote rural communities in developing countries may have difficulties in handling the costs of veterinary services, it is acknowledged that dog attachment and owners' perception of risk and disease knowledge are associated with the willingness to voluntarily purchase preventatives.

References

1. Das A, Anvikar AR, Cator LJ, Dhiman RC, Eapen A, et al. (2012) Malaria in India: The center for the study of complex malaria in India. Acta Trop 121: 267-273.
2. Morse SS (2001) Factors in the emergence of infectious diseases. Emerg Infect Dis 8: 8-26.
3. Muraleedharan K (2015) Babesia and babesiosis in livestock of Karnataka state, Indian overview. Vet Res Int 3: 81-82.
4. Lederberg J (2000) Infectious history. Science 288: 287-293.
5. Alto BW, Connelly CR, O'Meara GF, Hickman D, Karr N (2014) Reproductive biology and susceptibility of Florida Culex coronator to infection with West Nile virus. Vector Borne Zoonotic Diseases 14: 606-614.
6. Gubler D J (2009) Vector-borne diseases. Rev Sci Tech 28: 583-588.
7. Riggs MM, Sethi AK, Zabarsky TF, Eckstein EC, Jump RL (2007) Asymptomatic carriers are a potential source for transmission of epidemic and nonepidemic Clostridium difficile strains among long-term care facility residents. Clin Infect Dis 45: 992-998.
8. Roopali B, Mahadappa P, Satheesha SP, Sandeep H, Kasaralikar V, et al. (2017) Acute hepatozoonosis in dogs: A case report. Journ Para Dis 41: 747-749.
9. Woldehiwet Z (2010) The natural history of Anaplasma phagocytophilum. Veterinary Parasitology 167: 108-122.
10. Maharana BR, Kumar B, Prasad A, Patbandha TK, Sudhakar NR , et al. (2016) Prevalence and assessment of risk factors for haemoprotozoan infections in cattle and buffaloes of South-West Gujarat, India. Indian J Anim Res 50: 733-739.
11. Singh H, Jyoti, Haque M, Singh NK, Rath SS (2013) PCR based detection of subclinical bovine babesiosis in Punjab. Indian J Anim Res 47: 543-546.
12. Kolte SW, Larcombe SD, Jadhao SG, Magar SP, Warthi G , et al.(2017) PCR diagnosis of tick-borne pathogens in Maharashtra state, India indicates fitness cost associated with carrier infections is greater for crossbred than native cattle breeds. Plos One 12: e0174595.
13. Rani PAMA, Irwin PJ, Coleman GT, Gatne M, Traub RJ (2011) A survey of canine tick-borne diseases in India. Parasites Vectors 4: 141-148.
14. Barker SC, Murrell A (2004) Systematics and evolution of ticks with a list of valid genus and species names. Parasitology 129: 15-36.
15. Rufener L, Danelli V, Bertrand D, Sager H (2017) The novel isoxazoline ectoparasiticide lotilaner (Credelio™): A non-competitive antagonist specific to invertebrates γ-aminobutyric acid-gated chloride channels (GABACls). Parasit Vectors 10: 530-533.
16. Pfister K, Armstrong R (2016) Systemically and cutaneously distributed ectoparasiticides: A review of the efficacy against ticks and fleas on dogs. Parasit Vectors 9: 436-441.
17. Otranto D, Wall R (2008) New strategies for the control of arthropod vectors of disease in dogs and cats. Med Vet Entomol 22: 291-302.
18. Dryden M, Payne P, Smith V (2007) Efficacy of selamectin and fipronil-(S)-methoprene spot-on formulations applied to cats against adult cat fleas (Ctenocephalides felis) flea eggs, and adult flea emergence. Vet Ther 8: 255-262.
19. Coura JR, Suarez-Mutis M, Ladeia-Andrade S (2006) A new challenge for malaria control in Brazil: Asymptomatic Plasmodium infection: A review. Memorias do Instituto Oswaldo Cruz 101: 229-237.
20. Fuente J, Contreras M (2015) Tick vaccines: Current status and future directions. Expert Rev Vaccines 14: 1367-1376.
21. Kocan KM, Fuente J, Blouin EF, Coetzee JF, Ewing SA (2010) The natural history of Anaplasma marginale. Vet Parasitol 167: 95-107.
22. Busani L, Platonov AE, Ergonul O, Rezza G (2017) How to tackle natural focal infections: From risk assessment to vaccination strategies. Adv Exp Med Biol 972: 7-16.
23. Ghosh S, Nagar G (2014) Problem of ticks and tick-borne diseases in India with special emphasis on progress in tick control research: A review. Journal of Vector Borne Diseases 51: 259-270.