Vector-Borne Zoonotic Diseases

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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 Maharashtra [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.

Ehrlichiosis

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 eyes or ears. 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