CCHFV VECTOR ECOLOGY

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CCHF is the most widespread tick-borne viral disease of humans. It has been recorded from more than 30 countries [1-3]. Humans acquire the infection via tick bites, crushing of infected ticks or contact with viraemic animals blood or tissues. Nosocomial infections due to contact with infected patients are also common. Still the most important route seems to be tick bites [1, 3]. Ticks are accepted as the reservoirs of the infection. Animals can be viraemic for up to 2 weeks and ticks can harbour the virus lifelong (1 year) and can also maintain it by transstadial transovarial transmission [1, 4] Although CCHFv has been isolated from about 30 tick species, the vector competence has been demonstrated only for limited number of tick species (Amblyomma variegatum, Hyalomma marginatum, H. rufipes, H. anatolicum, H. asiaticum, H. truncatum, H. impeltatum, Dermacentor marginatus, Rhipicephalus evertsi, Rh. rossicus), among which Hyalomma species are strictly associated with the global distribution of the disease [1, 4-8]. The tick species associated with the current CCHF epidemic in Turkey is H. marginatum [9, 10]. Hyalomma ticks can transmit the virus transstadially and transovarially [1, 4-7, 12-14] Non-viraemic transmission among co-feeding ticks [7, 15, 16] and venereal transmission have also been demonstrated [15].

Hyalomma marginatum is associated with wildlife and is adapted to steppe climate. It is a two-host tick which' immatures (larvae and nymphs) feed on small mammals (hare, hedgehog) and ground frequenting birds (rooks, partridges). Fed larvae molt on the host and became nymphs which drop-off the ground when engorge. The feeding period of immatures (larvae, nymphs) takes about 14-26 days. Engorged nymphs molt to adults in about 4-20 days on the ground. The time when newly formed adults appear is about late August-September. Those adults prefer to hide and overwinter in nature and activate in the spring of the following year. The adults of H. marginatum are of hunter character and instead of vertical climbing on vegetation they actively seek/wait hosts horizontally on the ground. They mostly prefer artiodactyls (cattle, sheep/goats, horses, wild boars) but can aggressively attack humans as well. When attached to a host they feed for about 9-14 days. Engorged females drop-off on the ground and lay about 7000 eggs before they die. The whole life cycle of H. marginatum takes about a year [11, 17-20]. The ability of H. marginatum to overwinter is one of the main factors which is allowing of the transmission of CCHF virus from year to year. [1, 18].

Adults of H. marginatum are responsible of CCHF infections in humans in the Balkans, Crimea, Sothern Federal Districts of Russian Federation and Turkey. Adult ticks become active in spring when average temperatures reach 10.5 C. They actively seek/wait for a host when average temperatures are 22-27 C and humidity is 75-100%. When air temperature increases above 30 C and soil temperature above 45 C ticks preffer to hide even burry in the soil [11, 20].

CCHF epidemics in Balkans, Crimea, Southern Federal Districts of Russia have been always associated with ecological changes leading to increase of wild animals and H. marginatum population [1, 18].

In Turkey first cases were diagnosed in 2002 and until the end of 2023 more than 16000 cases were reported from about 3500 rural settlements. The overall mortality was 4.5%. In Turkey it has been shown that H. marginatum is the dominant species in the CCHF areas. [9, 10]. It has been also demonstrated that H. marginatum is transmitting the virus both transovarrialy and transstadially. [10, 21] and 5-18% of host seeking H. marginatum ticks were CCHFv infected [22].

Tick population dynamics are influenced by biotic and abiotic factors [23, 24]. The habitat suitability maps for Hyalomma marginatum were prepared and analyzed

against spatial distribution of CCHF in Turkey. The disease risk was strongly associated with presence of H. marginatum and landscape fragmentation. [10, 25]. The empirical observations on habitat regeneration and its influences on wildlife and tick abundance still need to be discussed. Hare (for immature ticks) and cattle (for adult ticks) seem to be main hosts involved in the H. marginatum biology in the epidemic area in Turkey. Both animals support tick population and are also involved in viral circulation [21]. We still need data on other wild animals such as wild boars, which' population is dramatically increased in the region, and other tick species as well (eg. D. marginatus) to explain the enzootic cycle of CCHF in Turkey. Also changes in socio-economics (migration from rural areas to urban areas) and animal husbandry (eg. decrease of sheep population) should be studied in details.

1. Hoogstraal, H., The epidemiology of tick-borne Crimean-Congo hemorrhagic fever in Asia, Europe, and Africa. J Med Entomol, 1979. 15(4): p. 307-417.
2. Ergonul, O., Crimean-Congo haemorrhagic fever. Lancet Infect Dis, 2006. 6(4): p. 203-14.
3. Whitehouse, C.A., Crimean-Congo hemorrhagic fever. Antiviral Res, 2004. 64(3): p. 145-60.
4. Turell, M., Role of Ticks in the Transmission of Crimean-Congo Hemorrhagic Fever Virus, in Crimean-Congo Hemorrhagic Fever: A Global Perspective, O. Ergonul and C.A. Whitehouse, Editors. 2007. p. 143-154.
5. Camicas, J.L., et al., [Crimean-Congo hemorrhagic fever in Senegal. Latest data on the ecology of the CCHF virus]. Bull Soc Pathol Exot, 1994. 87(1): p. 11-6.
6. Dohm, D.J., et al., Transmission of Crimean-Congo hemorrhagic fever virus by Hyalomma impeltatum (Acari:Ixodidae) after experimental infection. J Med Entomol, 1996. 33(5): p. 848-51.
7. Logan, T.M., et al., Experimental transmission of Crimean-Congo hemorrhagic fever virus by Hyalomma truncatum Koch. Am J Trop Med Hyg, 1989. 40(2): p. 207-12.
8. Korsunova, O.S. and S.P. Petrova-Pointkovskaya, A virus isolated from Hyalomma marginatmn marginatum Koch, ticks. Zool. Zh. , 1949. 28(2): p. 186-187. (Translation 793 (T793), Medical Zoology Department, US NAMRU, Cairo, Egypt).
9. Tonbak, S., et al., Crimean-Congo hemorrhagic fever virus: genetic analysis and tick survey in Turkey. J Clin Microbiol, 2006. 44(11): p. 4120-4.
10. Vatansever, Z., et al., Crimean-Congo Hemorrhagic Fever in Turkey, in Crimean-Congo Hemorrhagic Fever: A Global Perspective, O. Ergonul and C.A. Whitehouse, Editors. 2007. p. 59-74.
11. Emelianova, I.N., Hyalomma Koch, 1844 (ACARI: IXODIDAE) ticks of Central Precaucasia and surrounding territories. (Distribution, ecology, role in the natural foci of Crimean-Congo heamorrhagic fever), in MSc thesis in Biology. 2006, State University of Stavropol: Stavropol. p. 146p.
12. Faye, O., et al., [Experimental transmission of Crimean-Congo hemorrhagic fever virus: role of 3 vector species in the maintenance and transmission cycles in Senegal]. Parasite, 1999. 6(1): p. 27-32.
13. Faye, O., et al., [Experimental transmission of Crimean-Congo hemorrhagic fever virus by Rhipicephalus evertsi evertsi (Acarina:Ixodidae)]. Bull Soc Pathol Exot, 1999. 92(3): p. 143-7.
14. Pak, T.P., et al., Biocenotic interrelationships between Crimean hemorrhagic fever, ixodid ticks, and their hosts. Report 1. Results from virological investigations of ixodid and argasid ticks in Tadzhik SSR. Sborn. Trud. Ekol. Virus., 1974. 2: p. 135-139. (Translation 783 (T783), Medical Zoology Department, US NAMRU, Cairo, Egypt).
15. Gonzalez, J.P., et al., Sexual and transovarian transmission of Crimean-Congo haemorrhagic fever virus in Hyalomma truncatum ticks. Res Virol, 1992. 143(1): p. 23-8.

16. Gordon, S.W., K.J. Linthicum, and J.R. Moulton, Transmission of Crimean-Congo hemorrhagic fever virus in two species of Hyalomma ticks from infected adults to cofeeding immature forms. Am J Trop Med Hyg, 1993. 48(4): p. 576-80.
17. Pomerantsev, B.I., [Ixodid ticks (Ixodidae)]. Fauna of the USSR, Paukoobraznyye. new series 41, 4(2), 224 pp. 1950.
18. Berezin, V.V., Investigation of the ecology of arboviruses in river deltas of the Caspian and Azov sea basins. . (Avtoref. Diss. Soisk. Uchen. Step. Dokt. Biol. Nauk). Inst. Polio. Virusn. Entsefalitov, Akad. Med. Nauk SSSR, Moscow. 37 p. (In Russian). (In English, NAMRU3-T1160). 1971.
19. Petrova-Piontkovskaya, S.P., Biological and ecological data on the tick Hyalomma marginatum Koch in the northwestern Crimean hemorrhagtc fever focus. . Nov. Med., 1947. 5: p. 21-24. (Translation 864 (T864), Medical Zoology Department, US NAMRU, Cairo, Egypt).
20. Ouhelli, H., Comparative development of Hyalomma marginatum (Koch, 1844), H. detritum (Schulze, 1919), H. anatolicum excavatum (Koch, 1844), H. lusitanicum (Koch, 1844) and H. dromedarii (Koch, 1844) under laboratory conditions. Acta Parasitologica, 1994. 39(3): p. 153-157.
21. Vatansever, Z., et al., Prevalance of Crimean Congo Haemorrhagic Fever virus in ticks collected from domestic and wild animals in Turkey. , in VI. International Conference on Ticks and Tick-borne Pathogens. 2008: 21-26 September, 2008, Buenos Aires, Argentina.
22. Vatansever, Z., et al. The prevalence of Crimean-Congo heamorrhagic fever virus in the host seeking ticks in an endemic area of Turkey. in INTERNATIONAL CONFERENCE EDEN 2010, Emerging Vector-borne Diseases in a Changing European Environment. 2010. Le Corum, Montpellier, France.
23. Randolph, S.E. and D.J. Rogers, Tick-borne Disease Systems: Mapping Geographic and Phylogenetic Space. Adv Parasitol, 2006. 62: p. 263-91.
24. Randolph, S.E., Tick ecology: processes and patterns behind the epidemiological risk posed by ixodid ticks as vectors. Parasitology, 2004. 129 suppl.: p. S37-66.
25. Estrada-Pena, A., et al., Modeling the Spatial Distribution of Crimean-Congo Hemorrhagic Fever Outbreaks in Turkey. Vector-Borne and Zoonotic Diseases, 2007. 7(4): p. 667-678.