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Mini Review

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Viral Zoonosis Control and Eradication: Best Addressed Through One Health Approach

Abstract

The continuous threatening of the public health by a wide variety of pathogens is evident. While pathogens used to perpetuate between animals, wild and domesticated, and humans, zoonosis dominates. This perpetuation led to continuous evolution of viral zoonoses and emergence of new threats. Such situation call for the need for new and holistic investigative approaches that could enable better understanding of the epidemiology of these viral diseases, and further aid developing future strategies to control and mitigate their associated risk. This review is an attempt to shed light on some of the factors that play role in the perpetuation and evolution of viral zoonoses. In addition, the review was intended to highlight the importance of the problem and suggests alternative approach, One Health approach.

Keywords: Viral zoonosis, Viral zoonosis factors, One health approach

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Abbreviations: OH, One Health; WNV, West Nile Virus; MERS-CoV, Middle East Respiratory Syndrome-Coronavirus; SARS, Severe Acute Respiratory Syndrome

Introduction

Far beyond professionalism barriers, it is globally accepted that animals play an important role in public health arena, and that they are significantly affecting human health evolving zoonosis and pathogens' mutation. With a significant representation of more than 75% of the newly emerging diseases, viral zoonoses are among the top challenges threaten public health. While all known arthropod-borne viruses (arboviruses) are zoonotic pathogens, several arthropod vectors and Animal species including birds, goats, sheep, cattle, camels and wildlife fauna are claimed to be either definite hosts,[1] reservoirs or carriers,[2-5] for viral zoonoses.

However, while research zoonotic diseases often focuses on infectious diseases animals transmitting to human, an increasing number of reports indicate that humans are transmitting reversely pathogens, including viruses, to animals creating what is known as zooanthroponosis.[6] The recent episode of influenza A virus outbreaks is a good example. Excluding the Antarctica, several reports of zooanthroponosis were quoted everywhere.[6] Beside, while arthropods known to be potential viremic vectors for transmission of viral diseases to mammalian reservoirs, carriers or definite hosts, could serve to sustain nonviremic viral transmission among them[7] a case indicating status of worldwide public health havoc.

This situation has initiated the authors to give a mini review insight aiming at casting light on the importance of viral zoonoses at public health level, and over viewing some of the major factors that could maintain its perpetuation and viral novelty. Further, the authors also are trying to encourage the use of multidisciplinary approaches such One Health (OH) approach,[8,9] and investigating the risk associated with viral zonooses in hope of developing cost effective strategies to mitigate and eliminate their associated risk.

Discussion

The fact that viruses could infect many living species including man and animal with high potentiality to cross the species barriers is evident.[10,11] Several human interventions were found to be positively affecting viral zoonoses perpetuation. The global tendency to secure food with low production cost has initiated new trends of communal animal rearing and feeding practice that finally might lead to ease viral crossing species barriers. As the fact of provision of close multi-replication vehicles, evolution of mutant viruses is expected. Besides, the increase in human-animal contact exemplified by the growth in pet industry and changing from domestic to exotic could also create more chances for reverse viral zoonoses alongside maintenance of animal-human viral zoonoses.

Globalization and habitat changing, growly and/or destructively, might create favorable conditions for introduction and establishment of disease vectors in new geographic regions supporting local transmission of exotic diseases.[12] For example, the introduction of West Nile virus (WNV) to the United States in late 1999 has led to an unprecedented expansion into the Americas. In addition, the autochthonous transmission of chikungunya virus[13] and dengue virus has become a reality in Southern Europe since the local introduction and establishment of Aedes albopictus, an originally Asian mosquito vector referred to as the Asian tiger mosquito, through trade in used tires.[14, 15] The increased global connectedness of populations should also be guarded. Movements through international traveling and trade systems create conditions favoring rapid dispersal of new infectious diseases. Several viral diseases were observed to be a threat to public health due to this factor. The Severe Acute Respiratory Syndrome (SARS) outbreak in 2003, the recent outbreak of Middle East Respiratory Syndrome-Corona virus (MERS-CoV) in Korea[16] and the global spread of the swine-origin influenza A-H1N1 in 2009 emerging from Mexico and USA[17] are typical examples of this. The emergence and rapid spread of chikungunya virus in the America's in 2013/2014[18] and the rapid spread of Ebola virus in West Africa and its introduction into North America and Europe in 2014 by returning travelers and health-care workers[19] are recent replicates of the travelling factor.

While connectedness is efficient, long-distance transmission of some zoonotic viral diseases is also approved[20] a situation that could globally sustain circulation of viral zoonoses.

The biological characteristics of the viruses themselves could be a crucial factor for perpetuation of viral zoonoses. Aiming to reproduce, viruses use their diverse nucleic acid composition to propagate following the central dogma of replication as in case of ds-DNA and ss-DNA viruses. Here, the DNA template serves as mRNA to code for the progeny proteins.[21] Opposite to this, ss-RNA and ds-RNA virses have to synchronize reversely going primarily via a DNA phase before coding and concluding their replication process.[22]

As an extra step that obligates biochemical configuration added to small-sized genetic material of most of the RNA viruses, and lack of replication proofreading system, viral mutation is anticipated leading to virus novelty. The emergence of about five new SARS strains[23] since the last evolution of the disease in 2003 is a true example of that. Moreover, given that the whole replication steps are performed at the infected host-cell milieu, and that crossing of the species barriers is solely a virus potentiality[24] triggered by viral evolutionary mechanisms and virus-host interactions, the progeny viruses would expect to attain combinative reactions enabling it to bridge the species barriers and creating viral zoonosis. This is especially evident in replication of enveloped viruses, a case that is observed in coronaviruses.[25,9]

Conclusion

Considering the wide-based understandings currently evoked utilizing different disciplines and specializations to suit the term OH approach, a multidisciplinary scientific approach is needed to reveal the continuous cycling of zoonotic diseases worldwide. The involvement of the public health concerns, among which are the veterinarians, medicals, biologists and ecologists might be appropriate to investigate emerging and reemerging of viral zoonosis. With the ultimate goal to mitigate risks arose by viral zoonoses, the foreseen joint venture OH elements should result in improving diagnostic capacities and capability, augmenting treatment trends, providing the rationale and models for strengthening targeted surveillance for emerging infectious zoonotic viral diseases and providing data and evidence that would ultimately guide and reinforce cost-effective prevention campaigns.

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Conflicts of interest

None.

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