Atlas of Science
another view on science
http://atlasofscience.org

Arthropod-specific viruses: where did they come from, what are they doing and where are they going?

Among the hundreds of arthropod-borne viruses (arboviruses), some, for example dengue, West Nile, and yellow fever, cause significant human infections. Millions of infections with symptoms ranging from mild fever to fatal encephalitis occur annually. The suffering is great, and associated health care costs and economic impact are enormous.

More than 40 years ago Stollar and Thomas isolated "cell fusing agent" from *Aedes aegypti* mosquito cells. The virus was shown to not reproduce in vertebrates. In 1999 Kamiti River virus, another of these "arthropod viruses", was detected in other mosquitoes, and thereafter many phenotypically similar viruses have been detected in mosquitoes, ticks, midges and other invertebrates. Some are pathogenic for their arthropod hosts but not for vertebrates.

In the past, methods to detect and isolate viruses was accomplished using laboratory animals or cultured cells. More recently, nucleic acid detection using molecular methods has allowed us to quickly and specifically identify viruses without isolating them. It is likely that we had missed identifying these arthropod viruses.

Of more than 80 arthropod viruses described, most can be assigned to well-defined virus families of arboviruses and non-arboviruses. Further study of isolates, however, may reveal that some can infect vertebrates.

The biology of these unusual arthropod-restricted viruses, modes of transmission, global distribution (some, for example, have been found in both Asia and the United States), the characteristics of their genomes, and their potential to become vertebrate pathogens or at least serve as virus reservoirs, are fascinating and may provide information useful in preventing disease, in devising vaccines, and in understanding virus evolution.

Studies or arthropods suggest that their genomes may be the sources of arthropod virus genes. Further studies on the virus-vector relationship may provide insights into the evolution of the arthropods themselves and answer remaining key questions.

Are arthropods simply passive participants in all this? Arthropods do not produce anti-viral antibody, that in vertebrates may result in selection of, for example, more pathogenic viral populations.

Why are some of these arthropod viruses pathogenic for arthropods and for arthropod cells in culture and others not? Perhaps they are in equilibrium with each other after having co-existed and evolved together over time.

What are the gains and losses for the virus and its vector in regard to virus variants, "fitness", and other manifestations of adaptation? In other words, what has changed genetically when a virus adapts to a new host and what are the results of the modifications of characteristics that might have taken place? This and other questions lead us to ask why many viruses are not transmitted by arthropods.

Are the genomes of all arthropod viruses hidden within arthropod genomes? If arthropod viral genomes may, in part, comprise arthropod genomes, might this provide clues to arthropod evolution and virus evolution?

How many viruses can co-multiply in a single arthropod cell? Although multiple virus co-infections of mosquitoes have been reported under some circumstances, at least some arthropod viruses prevent superinfection (interfere) with related viruses.

Why are at least some of these arthropod viruses so widely distributed geographically with apparently little genetic divergence? Arthropod viruses may represent genetic elements that have adapted to existence irrespective of a vertebrate host and which have transitioned to such a life cycle. They may be forms of viruses that have not yet transitioned to vertebrate-dependent forms. In other words, these arthropod viruses may be evolutionary failures or evolutionary successes, and are potential vertebrate pathogens?

Perhaps as interesting is the question of the very existence of these viruses. That is, what are they doing, other than persisting?

Calisher CH[1], HIggs S[2]
[1]*Department of Microbiology, Immunology and Pathology, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort* virus, arthropod, evolution *Collins, CO, USA*
[2]*Director Biosecurity Research Institute, 1041 Pat Roberts Hall, Kansas State University, Manhattan, Kansas, USA*

Publication

The Discovery of Arthropod-Specific Viruses in Hematophagous Arthropods: An Open Door to Understanding the Mechanisms of Arbovirus and Arthropod Evolution?
Calisher CH, Higgs S
Annu Rev Entomol. 2018 Jan 7