Zika Virus Update: Research, Models, Diagnostics

Amid rising concern over the rapid geographic spread of the Zika virus and expanding public health risks from outbreaks that it is causing, related research and other activities are surging. Recent examples include:

- Analysis of blood samples from patients who developed Guillain-Barré syndrome (GBS) during a 2013–2014 Zika virus outbreak in French Polynesia supports the view that infections with this virus cause GBS, according to Arnaud Fontanet from the Institut Pasteur, Paris, France, and his collaborators. Details appeared 29 February 2016 in The Lancet (doi: http://dx.doi.org/10.1016/S0140–6736(16)00562–6).
- Case studies of pregnant women indicate that the Zika virus crosses the placental barrier, according to Ana de Filippis of the Oswaldo Cruz Institute in Rio de Janeiro, Brazil, and her collaborators. Details appeared 17 February 2016 in The Lancet Infectious Diseases (doi:http://dx.doi.org/10.1016/S1473–3099(16)00095–5).
- A three-dimensional, cell-based model of the human placenta that resists infection by viruses and the parasite Toxoplasma gondii could be used to study whether and how Zika virus or other pathogens cross the placenta to cause birth defects, according to Carolyn Coyne of the University of Pittsburgh School of Medicine and her collaborators. Details appeared 4 March 2016 in Science Advances (doi: 10.1126/sciadv.1501462).
- In another model study, Zika virus “efficiently infects” human neuronal cells in vitro that are counterparts to those that form the cortex during brain development, according to Guo-li Ming and Hongjun Song of the Johns Hopkins University School of Medicine in Baltimore, Md., and Hengli Tang of Florida State University in Tallahassee. Details appeared 4 March 2016 in Cell Stem Cell (doi:10.1016/j.stem.2016.02.016).
- The gene-editing capabilities of the CRISPR-Cas9 system, if used to drive “male-determining” genes through mosquito populations, could make it feasible to control Zika-virus-carrying mosquitoes, according to Zach Adelman and Zhijian Tu at Virginia Tech in Blacksburg. Details appeared March 2016 in Trends in Parasitology (http://dx.doi.org/10.1016/j.pt.2015.12.003).
- Siemens Healthcare Diagnostics of Berlin, Germany, in March said it would release its PCR-based test for Zika virus; the test is for research use only and, although designed to run on the Siemens Versant system, it also can run on other commercially available PCR systems, the company said.
- Responding to a request from the Centers for Disease Control and Prevention, Food and Drug Administration (FDA) officials in February authorized for emergency use an antibody capture-based ELISA test for detecting Zika virus in blood specimens.

stranded RNA—to mimic a viral infection—inducing ASD-like symptoms in pups, including abnormalities in brain development as well as behavior and social interactions that persist into adulthood. These symptoms in newborn mice are accompanied by alterations in immune signaling—specifically, IL-17a receptors are upregulated in cortical layers of the brains, where structural defects arise, of the developing fetuses. Expression of IL-17a also is enhanced in maternal mononuclear cells throughout the placenta and uterine tissue during pregnancy. “Dysregulated levels of IL-17a have been detected in the serum of a subset of autistic children.” IL-17 is also implicated in numerous autoimmune diseases in humans, including rheumatoid arthritis, irritable bowel syndrome, and multiple sclerosis. Based on results in mice with ASD, therapeutics against these diseases, including antibodies against IL-17 and the upstream IL-6 receptor, might prove useful in treating ASD, according to Choi.

Children with ASD have similar immune abnormalities, Choi adds. “Elevated levels of IL-17a have been detected in the serum of a subset of autistic children.” IL-17 is also implicated in numerous autoimmune diseases in humans, including rheumatoid arthritis, irritable bowel syndrome, and multiple sclerosis. Based on results in mice with ASD, therapeutics against these diseases, including antibodies against IL-17 and the upstream IL-6 receptor, might prove useful in treating ASD, according to Choi.

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**NEW FROM ASM**

**Sequencing, Not Culture, Proved Fast Way To Find New Hot Spring Virus**

**Carol Potera**

Culture-independent methods are making it possible to discover and partly characterize viruses and their hosts straight from hot springs such as those in Yellowstone National Park (YNP)—short-circuiting the traditional approach that depends on first growing samples in vitro, according to Rebecca Hochstein at Montana State...
University (MSU) in Bozeman and her collaborators. In this way, they discovered the *Acidianus* tailed spindle virus (ATSV), which infects archaeal species found in the Crater Hills Thermal Basin of YNP. Details appeared 13 January 2016 in the *Journal of Virology* (doi: 10.1128/JVI.03098–15).

“We started with the virus, not the host,” Hochstein says. “That’s unique. The viral genome gave us the first hint of what was there. This virus-centric approach enables researchers to go after a specific virus of interest, instead of whatever virus is most amenable to culturing.” This approach “could be used to discover viruses in oceans, lakes, soils, and almost any environment you could think of,” adds study leader Mark Young of MSU. “It greatly expands our understanding of viral diversity on the planet and the role viruses play in the ecology and evolution of life.”

We in biology “know so little about the diversity of viruses on Earth and their effect on microbial populations,” says Rachel Whitaker at the University of Illinois, Urbana, who was not involved in the MSU research. “This type of work makes a strong impact on expanding our view of viruses in this natural model system for virus ecology and evolution.”

In addition to sequencing the viral genetic material, the MSU researchers used an assortment of other molecular methods, including CRISPR/Cas, viral FISH, 16S rRNA, quantitative PCR, and transmission electron microscopy, to build a picture of ATSV and identify its host, which they say is *Acidianus hospitalis* or a closely related species.

Members of this genus, recognized in the mid-1980s, are thermoacidophilic archaeabacteria, generally found in solfatara fields and marine hydrothermal systems; they grow as facultative aerobes by lithotrophic oxidation and reduction of sulfur dioxide.

ATSV is a new member of the group of archaeal large spindle viruses that includes *Acidianus* two-tailed virus, *Sulfolobus tengchongensis* spindle-shaped virus 1 and 2, and *Sulfolobus* monoaudavirus, according to Hochstein. All are found in hot springs worldwide, replicate in archaeal hosts, and share similar shapes and a set of seven core genes, including genes that encode a coat protein, an integrase, and multiple ATPases. Strikingly, ATSV has a large head and a very long tail that, when magnified, looks like ropes of protein molecules. In part for that reason, the MSU team proposes that ATSV and its relatives constitute a new family, which they call *Fusellocaudaviridae* based on their shape and tail.

Much less is known about geothermal viruses, especially the archaeal viruses, than about the bacteria that are recovered from hot springs at YNP. Viruses that thrive at near-boiling temperatures and acidic conditions have unusual morphologies and a wealth of genes with possible industrial applications, according to Hochstein. “The coat proteins of these viruses offer options for making nanomaterials, such as ‘cages’ to deliver drugs or other materials,” she says.

Carol Potera is a freelance writer in Great Falls, Mont.

**RESEARCH ADVANCES**

**Unexpected Taxa and Mixotrophy Help To “Sink” Carbon in Oceans**

Barry E. DiGregorio

In nutrient-poor regions of the ocean, several types of “unexpected taxa” are “most strongly associated with carbon export,” according to Lionel Guidi from the CNRS Laboratoire d’Océanographie de Villefranche-sur-Mer in France and his collaborators. Separately, but also unexpectedly, mixotrophy appears to play a larger than previously appreciated role in sequestering carbon into the ocean’s depths, according to Ben Ward from the University of Bristol in the United Kingdom and Michael Follows of the Massachusetts Institute of Technology in Cambridge, Mass.

Teasing apart these relative roles is a gateway to better understanding the dynamics of global carbon cycling.