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Serologic Evidence of Hantavirus Infection in Sigmodontine Rodents in Mexico

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ABSTRACT: Antibodies to hantaviruses in two species of sigmodontine rodents (*Peromyscus maniculatus* and *Reithrodontomys sumichrasti*) collected in central Mexico are reported. *Peromyscus maniculatus,* a common species throughout much of Mexico, is the reservoir of Sin Nombre virus (SNV), the etiologic agent of the great majority of cases of hantavirus pulmonary syndrome (HPS) in North America. Although the identity of the virus detected in *P. maniculatus* in Mexico could not be determined by these serologic results, our findings suggest that SNV may occur throughout the range of *P. maniculatus* in North America. If true, the failure to identify HPS in Mexico is not due to the absence of pathogenic hantaviruses in Mexico.

Key words: Antibodies, deer mouse, Hantavirus, rodents, *Peromyscus maniculatus,* Sigmodontinae, Sin Nombre virus.

Hantaviruses occur naturally in association with rodent reservoir hosts of the family Muridae in Asia, Europe, and the Americas (Schmaljohn and Hjelle, 1997; Peters et al., 1999). Hantavirus infection in rodent hosts causes a chronic, asymptomatic infection that involves the shedding of infectious virus in urine, feces, and saliva. Virus also may be transmitted among rodents by bites during intraspecific aggression (Mills et al., 1997). Transmission to humans appears to occur via inhalation of aerosolized virus, direct contact with broken skin or mucous membranes, or rodent bites. About two dozen hantaviruses are currently recognized. About half of these are known to cause hantavirus pulmonary syndrome (HPS) in the United States, Canada, and Central and South America. All have reservoir species in the New World rats and mice (family Muridae, subfamily Sigmodontinae). Outbreaks or sporadic cases of HPS have occurred in Chile, Argentina, Uruguay, Paraguay, Brazil, Bolivia, and Panama. Overall mortality has been near 50%. Rodents with hantavirus antibodies have been captured in Peru, Venezuela, and Costa Rica although HPS has not been documented in humans from these contries.

Despite the common occurrence of hantaviruses and hantavirus disease north and south of Mexico, there have been no reported cases of HPS in that country. However, Hjelle et al. (1995) isolated hantavirus RNA from a *Reithrodontomys megalotis* captured in Zacatecas (Mexico). In addition, Mantooth et al., (2000) reported hantavirus antibody in *Peromyscus melanotis* and *Peromyscus hylocetes* collected in an oak forest in San Bartolo Morelos, in the state of Mexico, approximately 150 km to the west of Ajusco National Park. Neither of these rodent species has been associated with hantaviruses responsible for human disease.

The deer mouse, *Peromyscus maniculatus,* is the reservoir for Sin Nombre virus (SNV), the virus responsible for the great majority of human HPS cases in North America. Despite the documented occurrence of antibody-positive deer mice throughout its range in the USA and Canada, none have been reported from Mexico. Here, we provide the first evidence for hantavirus infection in deer mice in Mexico.

In May 1998, we collected 33 individuals of seven rodent species from two localities in central (Ajusco) and western (Chamela-Cuixmala biosphere reserve) Mexico. The specimens from Ajusco National Park, approximately 20 km south of Mexico City, were collected in a pine forest at 3,050 m; 19°16′N, 98°13′W. At this

locality we collected *Peromyscus maniculatus* ($n = 8$), *Microtus mexicanus* ($n = 1$), *Reithrodontomys sumichrasti* ($n = 1$).

Specimens from the Chamela-Cuixmala Biosphere Reserve, which is located on the coast of Jalisco at 50 m (19°22′N, 104°56′W, approximately 45 km from Barra de Navidad) were collected in a dry tropical forest at the Chamela Biological Station. At this locality we collected *Biomys musculus* ($n = 2$), *Oryzomys palustris* ($n = 1$), *Osgoodomys banderanus* ($n = 6$), and *Liomys pictus* ($n = 14$).

Animals were handled and blood collected according to Mills et al. (1995). Blood was tested for antibodies reactive with SNV recombinant nucleocapsid protein antigen by enzyme-linked immunosorbent assay (Feldmann et al., 1993) at the Centers for Diseases Control and Prevention (CDC; Atlanta, Georgia, USA) in 1999. One *Peromyscus maniculatus* and one *Reithrodontomys sumichrasti* had antibodies reactive with SNV antigen, with titers of 1/400. Both antibody-positive animals were from Ajusco National Park.

Finding antibodies to hantavirus in wild rodents in Mexico was not unexpected because viruses causing HPS have been found both north and south of Mexico. In addition, HPS and hantavirus-infected rodents are common in all the states of the USA bordering Mexico (California, Arizona, New Mexico, and Texas) and in many places south of Mexico. Pathogenic hantaviruses have been reported in four species of Sigmodontine rodents in Canada and the USA (*P. maniculatus, P. leucopus, Sigmodon hispidus,* and *Oryzomys palustris*) (Mills and Childs, 1998), all of which are also found in Mexico (Arita and Ceballos, 1997). *Peromyscus maniculatus,* is common over a large part of Mexico, attaining densities up to 50 individuals per hectare (Ceballos and Galindo, 1984).

Additionally, Mexico, with approximately 507 species of mammals, has the second or third highest mammalian diversity in the world (Ceballos and Brown, 1995; Mittermeier et al., 1998). Rodents represent 49% of these species, of which more than 50% (119 species), belong to the subfamily Sigmodontinae. This includes 46 species of *Peromyscus,* 13 *Reithrodontomys,* seven *Sigmodon,* and nine *Oryzomys* (Arita and Ceballos, 1997). All of these genera include species known to serve as reservoirs for species of hantavirus.

Peromyscus maniculatus is infected with SNV throughout its range in the U.S. (Mills and Childs, 1998). Further studies, including isolation and genetic sequencing of the virus will be required to show definitively that the virus present in Mexican deer mice is SNV. Nevertheless, the finding of a hantavirus-infected deer mouse in Central Mexico suggests that the species carries SNV throughout its range in North America. A second important implication of these findings is that failure to detect HPS in Mexico may not be due to the absence of hantavirus species in rodent reservoir populations, but may relate to failure to recognize human cases. In order to understand public health risks associated with hantaviruses in Mexico a thorough evaluation of the extent and distribution of these viruses in sigmodontine reservoir hosts in Mexico is needed.

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