Sociedade Brasileira de Infectologia

The Brazilian Journal of
INFECTIOUS DISEASES

www.elsevier.com/locate/bjid

Brief Communication

First study of Seoul virus (SEOV) in urban rodents from newly urbanized areas of Gran La Plata, Argentina

Bruno Fitte [a,*], *Julia Brignone* [b], *Carina Sen* [b], *María del Rosario Robles* [a]

[a] *Centro de Estudios Parasitológicos y de Vectores, CEPAVE (CCT La Plata CONICET UNLP), Buenos Aires, Argentina*
[b] *Instituto Nacional de Enfermedades Virales Humanas (INEVH) Dr. Julio I. Maiztegui, Buenos Aires, Argentina*

ARTICLE INFO

Article history:
Received 13 July 2022
Accepted 5 December 2022
Available online 19 December 2022

Keywords:
Urban rodents
Zoonosis
SEOV
America

ABSTRACT

Alterations of ecosystems have deep effects on the distribution of parasites. Big cities of Argentina present structural features that favor the presence of synanthropic species, acting as source of zoonotic diseases, for example in urban rodents: the Norway rat (*Rattus norvegicus*) and the black rat (*R. rattus*). One of the important zoonotic pathogens related are the RNA virus Hantavirus, with high prevalence rates in South America. The aim of this study was to explore and identify the presence of Hantavirus in urban rodents from Gran La Plata, Argentina. The presence of anti-hantavirus IgG antibodies was determined by the Enzyme-Linked Immunosorbent Assay. Six samples turned out positive for Seoul virus (SEOV, p = 14.3%). These are the first records of SEOV in urban rodents in Gran La Plata. It represents the first report in *R. rattus* in Argentina, and in America. This situation underscores the inequality and historical forgetfulness of a portion of society, calling for urgent action to be taken in this regard.

The rapid and extensive anthropogenic alterations of ecosystems are having deep effects on the distribution and ecology of organisms, including parasites.[1] Particularly big cities constitute obvious melting pots for the mixing of human and animal parasites and their potential for rapid spread, both locally and internationally.[2] This situation is even more pronounced when human and other animal species live in close contact due to structural and/or environmental conditions. In this way, Argentina is characterized by remarkable social and economic fragmentation, which has deepened during the 90′s.[3] Therefore, most of the big cities in Latin America are nowadays characterized by the presence of peripheral neighborhoods that present structural and environmental features that favor the presence of synanthropic species, which can act as source of zoonotic diseases.[4] Clear examples of synanthropic species are the urban rodents, represented by the Norway rat (*Rattus norvegicus* Berkenhput, 1769) and the black rat (*Rattus rattus* Linnaeus, 1758), originally from Southeast Asia and North Africa/West Asia respectively, among others.[5,6] A large number of pathogens and parasite species utilize urban rodents to fulfill part of their life cycle.[7] One of the most important zoonotic pathogens related to rodents, due to sanitary implications, are the RNA virus Hantavirus, which belong to the Hantaviridae family, genus Orthohantaviridae.[8] Hantaviruses are negative-sense, single-stranded RNA viruses with a small (< 11 kb) tripartite genome.[9] These viruses are cause of Hemorrhagic Fever with Renal Syndrome

* Corresponding author.
E-mail address: brunofitte@cepave.edu.ar (B. Fitte).
https://doi.org/10.1016/j.bjid.2022.102730

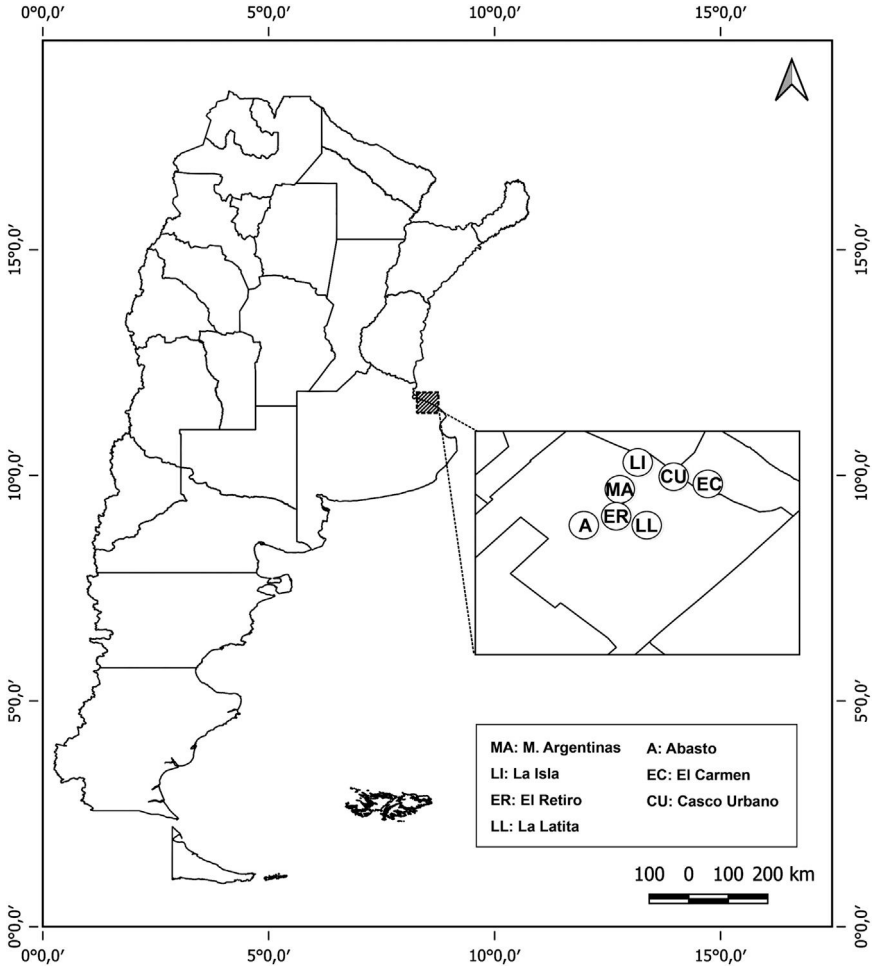

Fig. 1 – Map of the neighborhoods of Gran La Plata, Buenos Aires, Argentina. A, Abasto; CU, Casco Urbano; EC, El Carmen; ER, El Retiro; LI, La Isla; LL, La Latita; MA, Malvinas Argentinas.

(HFRS) in Europe and Asia, and Hantavirus Cardio Pulmonary Syndrome (HCPS) in America.[1]

Hantaviruses, unlike all other viruses in the family, are not transmitted by arthropod vectors. Most frequently, transmission is through inhalation of virus-contaminated aerosols of rodent excreta. Urban rodents (mainly genus *Rattus*) are reservoirs of Seoul virus (SEOV).[10] This species causes a moderate form of HFRS in urban populations. The infection in rodents is asymptomatic and persistent.[11] Although in America there are few records of human cases, in Argentina positive cases of SEOV in *R. norvegicus* have been reported since the 1980s.[11,12] Moreover, in recent years, serological and molecular evidence of SEOV circulation have been recorded in rodents from the Autonomous City of Buenos Aires.[13] So far, no human cases of HFRS due to SEOV have been recorded.[12] However, Approximately 150,000 to 200,000 cases of HFRS involving hospitalization are reported each year throughout the world.[14] In this context, the aim of this study was to identify the presence of Hantavirus in urban rodents from peripheral neighborhoods of Gran La Plata, Argentina.

The area of Gran La Plata includes the capital city of Buenos Aires province. It is located in the northeast of the province of Buenos Aires, Argentina. Sampling was carried out seasonally in seven neighborhoods: Malvinas Argentinas (34.5643°S, 58.0036°W), La Isla (34.5328°S, 57.5925°W), El Retiro (34.5751°S, 58.0017°W), La Latita (34.5831°S, 57.5830°W), Abasto (34.5805°S, 58.0147°W) and El Carmen (34.5533°S, 57.5309°W); Casco Urbano (34.5516°S, 57.5716°W; Fig. 1). These neighborhoods present different levels of urbanization. Most of them are characterized by poor environmental and structural features like inadequate garbage removal, lack of a sanitation network and potable water, with areas susceptible to flooding and with domestic animals without sufficient care. Only Casco Urbano, as part of La Plata city center, presents all services. Rodents were captured using cage live traps (15 × 16 × 31 cm), Sherman traps (8 × 9 × 23 cm) and snap traps (17.5 × 8.5 cm) and then euthanized. After necropsy, blood samples were extracted using the cardiac puncture technique, and stored at −70 °C. The presence of anti-hantavirus IgG antibodies was determined by the Enzyme-Linked Immunosorbent Assay (ELISA), following Calderon et al. 2018[15] using gamma irradiated Seoul virus antigens (lysate of infected Vero E6 cells). Each sample was processed in parallel with uninfected control antigen. Sera with OD greater than or equal to 0.2, and a titer greater than or equal to 1:400 were considered positive. Specimens were sacrificed following

procedures and protocols approved by national laws (Animal Protection National law 14.346 and references in the provincial permits) and the Laboratory, Farm and Wildlife Animals Research Ethics Committee of the National Council of Scientific and Technical Research (CONICET).

For this survey, a total of 42 rodents were captured and analyzed, 25 R. *norvegicus* and to 17 *R. rattus*. Six samples resulted positive to SEOV (overall prevalence of 14.3%): five R. *norvegicus,* representing a prevalence of 20%; and one *R. rattus*, representing a prevalence of 5.88%. Concerning *R. norvegicus*, three positive samples were detected in El Retiro neighborhood, one in La Isla, and one in El Carmen. The *R. rattus* positive sample was recorded in La Isla neighborhood.

These findings correspond to the first records of SEOV in urban rodents in Gran La Plata area and represents the first record of this virus in *R. rattus* in Argentina, and in the American continent. Concerning *R. norvegicus*, the prevalence rates here recorded are intermediate compared to previous surveys carried out in other areas of Argentina, which ranged from 11%[12,16] and 31%.[11] Despite studies that have been carried out, there are no reports of *R. rattus* in Argentina and in other countries of America;[12] in contrast, in Europe and Asia many cases have been reported.[17,18]

Although no cases of HFRS have not been recorded in humans in Argentina, cases were reported in other countries of America, for example in United States[19] and Brazil.[20] The record of transmission in other countries of the region and the close contact in which people coexist with urban rodents in neighborhoods favors the establishment and transmission of human infection. Particularly for this scenario, rodents were captured inside households (for example under the beds or into the kitchens), and in the backyards, which in all cases consist in very small surfaces with a mixture of grass and garbage. In any case the number of people living in these households was not less than three, allowing close everyday contact and representing a potential sanitary risk, becoming necessary for the government to incorporate in the agenda actions towards providing better living conditions for people, including rat control programs. Moreover, as other diseases caused by parasitic organisms, the risk represented by SEOV in these regions are examples of inequality and the historical forgetfulness of a portion of society, calling for urgent actions to be take in that regard.

Funding sources

This study was funded by PIO (Proyecto de Investigación Orientado) CONICET-UNLP.

Conflicts of interest

The authors reported no potential conflict of interest.

Acknowledgements

We thank all the people that offered their homes for carrying out the trapping; to Andrea Dellarupe, Juan M. Unzaga, Kevin Steffen, Juliana Sanchez, Macarena Zarza, Paola Cociancic, and Lorena Zonta for collecting hosts; to Carlos Galliari and Pablo Teta for the identification of hosts; and to Emilio Topa for the preparation of the tissue fragments (slides). This study was funded by PIO CONICET-UNLP.

REFERENCES

1. Dearing MD, Dizney L. Ecology of hantavirus in a changing world. Ann N Y Acad Sci. 2010;1195:99–112.
2. Webster JP, Gower CM, Knowles SC, Molyneux DH, Fenton A. One health—an ecological and evolutionary framework for tackling Neglected Zoonotic Diseases. Evol Appl. 2016;9:313–33.
3. Hancke D, Navone GT, Suárez OV. Endoparasite community of Rattus norvegicus captured in a shantytown of Buenos Aires City, Argentina. Helminthologia. 2011;483:167–73.
4. Cavia R, Cueto GR, Suárez OV. Changes in rodent communities according to the landscape structure in an urban ecosystem. Landsc Urban Plan. 2009;90:11–9.
5. Lobos G, Ferres M, Palma RE. Presencia de los géneros invasores Mus y Rattus en áreas naturales de Chile: un riesgo ambiental y epidemiológico. Rev Chil Hist Nat. 2005;78:113–24.
6. Puckett EE, Park J, Combs M, Blum MJ, Bryant JE, Caccone A, Himsworth CG. Global population divergence and admixture of the brown rat (Rattus norvegicus). Proc R Soc B. 2016;283:20161762.
7. Panti-May J, Digiani MC, Palomo-Arjona EE, Gurubel-gonzÁlez YM, Navone GT, Williams C, Robles MR. A checklist of the helminth parasites of sympatric rodents from two Mayan villages in Yucatán, México. Zootaxa. 2018;4403:495–512.
8. Milazzo ML, Duno G, Utrera A, Richter MH, Duno F, de Manzione N, Fulhorst CF. Natural host relationships of hantaviruses native to western Venezuela. Vector-Borne Zoonotic Dis. 2010;10:605–11.
9. Elliott RM. Molecular biology of the Bunyaviridae. J Gen Virol. 1990;71:501–22.
10. Schmaljohn C, Hjelle B. Hantaviruses: a global disease problem. Emerg Infect Dis. 1997;3:95.
11. Seijo A, Pini N, Levis S, Coto H, Deodato B, Cernigoi B, Enria D. Estudio de Hantavirus seoul en una población humana y de roedores en un asentamiento precario de la Ciudad de Buenos Aires. Medicina. 2003;63:193–6.
12. Cueto GR, Cavia R, Bellomo C, Padula PJ, Suárez OV. Prevalence of hantavirus infection in wild Rattus norvegicus and R. Rattus populations of Buenos Aires City, Argentina. Trop Med Int Health. 2008;13:46–51.
13. Hercolini C, Bruno A, Aristegui E, De Salvo MN, Vidal J, Bellomo C, Brambati DF. Hantavirus en roedores de La Ciudad de Buenos Aires circulación de hantavirus en oligoryzomys flavescens en Ciudad de Buenos Aires, Argentina. InVet. 2018;20:12–22.
14. Schmaljohn C, Hjelle B. Hantaviruses: a global disease problem. Emerg Infect Dis. 1997;3(2):95.
15. Calderón GE, Brignone J, Martin ML, Calleri F, Sen C, Casas N, Levis S. Brote de síndrome pulmonar por Hantavirus, Tucumán, Argentina. Rev Med. 2018;78:150–7.
16. Maiztegui JI, Becker JL, Le Duc JW. Actividad del virus de fiebre hemorrágica de Corea o virus muroide en ratas del puerto de la ciudad de Buenos Aires. Medicina. 1983;43:871.
17. Reynes JM, Soares JL, Hüe T, Bouloy M, Sun S, Kruy SL, Zeller H. Evidence of the presence of Seoul virus in Cambodia. Microbes Infect. 2003;5:769–73.
18. Lokugamage N, Kariwa H, Lokugamage K, Iwasa MA, Hagiya T, Yoshii K, Takashima I. Epizootiological and epidemiological

study of hantavirus infection in. Japan Microbiol Inmunol. 2004;48:843–51.
19. Childs JE, Ksiazek TG, Spiropoulou CF, Krebs JW, Morzunov S, Maupin GO, Frey JK. Serologic and genetic identification of Peromyscus maniculatus as the primary rodent reservoir for a new hantavirus in the southwestern United States. J Infect Dis. 1994;169:1271–80.
20. Iversson LB, Travassos da Rosa AP, Rosa MD, Lomar AV, Sasaki MG, LeDuc JW. Infeccao humana por hantavirus nas regioes sul e sudeste do Brasil. Rev Assoc Med Bras. 1994;40:85–92.