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REVIEW

Arbovirosis en las Américas: una revisión de dengue, Zika, chikungunya y fiebre amarilla

Arboviruses in the Americas: a review of dengue, Zika, chikungunya, and yellow fever

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ABSTRACT

Arboviruses are a major public health problem worldwide, particularly in Latin America. Among the most relevant are dengue, with its four serotypes, Zika virus, chikungunya virus, and yellow fever. These diseases, transmitted mainly by mosquitoes of the genus Aedes, share initial clinical manifestations, which makes differential diagnosis difficult. In addition, they present serious complications such as encephalitis, congenital microcephaly, chronic arthritis, and liver failure, which increase their impact on the population. This review article describes the virological, epidemiological, clinical, and preventive aspects of these arboviruses, highlighting the importance of vaccination, vector control, and epidemiological surveillance as the main prevention strategies.

Keywords: Arbovirus; Vector; Epidemiology; Transmission; Prevention.

RESUMEN

Las arbovirosis constituyen un importante problema de salud pública a nivel mundial, particularmente en América Latina. Entre las más relevantes se encuentran el dengue, con sus cuatro serotipos, el virus Zika, el virus chikungunya y la fiebre amarilla. Estas enfermedades, transmitidas principalmente por mosquitos del género Aedes, comparten manifestaciones clínicas iniciales, lo que dificulta su diagnóstico diferencial. Además, presentan complicaciones graves como encefalitis, microcefalia congénita, artritis crónica e insuficiencia hepática, que incrementan su impacto en la población. El presente artículo de revisión describe los aspectos virológicos, epidemiológicos, clínicos y preventivos de estas arbovirosis, resaltando la importancia de la vacunación, el control vectorial y la vigilancia epidemiológica como principales estrategias de prevención.

Palabras clave: Arbovirus; Vector; Epidemiología; Transmisión; Prevención.

INTRODUCTION

Arboviruses are a heterogeneous group of viruses transmitted by blood-feeding arthropods, mainly mosquitoes and ticks, and pose a growing challenge to global public health.(1) These viruses belong to various families, including Flaviviridae, Togaviridae, and Bunyaviridae, which cause medically essential diseases such as dengue, Zika, yellow fever, and chikungunya .(2)

In recent decades, the incidence of arbovirus infections has increased steadily in tropical and subtropical

regions, driven by factors such as the geographic expansion of vectors, unplanned urbanization, environmental and climatic changes, and increased human mobility.[3,4] These conditions have favored the co-circulation of multiple arboviruses, generating complex epidemiological scenarios and concurrent outbreaks across different Latin American countries.[5]

The clinical manifestations of arbovirus infections are variable. They can range from asymptomatic cases to severe forms that compromise vital organs, causing encephalitis, myocarditis, or liver failure, in some cases with fatal outcomes.[6,7] Dengue, chikungunya, and Zika virus infections are the main public health challenges in the region, given their epidemic potential and the absence of specific antivirals.[8]

Diagnosis is primarily based on serological and molecular methods that enable early detection of the virus or its antibodies; however, the availability of these tests varies across countries depending on local resources.[9] In terms of prevention, vector control remains the most effective strategy, complemented by health education campaigns [10] for dengue and yellow fever, and vaccination.[11]

In this context, it is essential to update knowledge on the biology, epidemiology, and preventive measures of arboviruses to strengthen surveillance and control strategies. This article aims to review the main epidemiological, clinical, and preventive aspects of the arboviruses with the most significant impact in Latin America, with an emphasis on dengue, Zika, chikungunya, and yellow fever.

Objectives

- Review recent scientific literature on the main arboviruses of medical importance, including their biological characteristics, transmission cycles, and geographic distribution.
- Analyze the clinical manifestations and complications associated with arbovirus infections, as well as the available diagnostic methods.
- Evaluate prevention and control strategies implemented worldwide, including vector management, vaccination, and health education.
- Identify knowledge gaps and areas for future research to improve the prevention, diagnosis, and treatment of these infections.

METHOD

An international literature review on arboviruses was conducted, focusing on articles published in the last 10 years (2015–2025).

The search was conducted in electronic databases such as PubMed, Scopus, Web of Science, and SciELO, using combinations of the terms: " r arbovirus," "dengue," "Zika," "chikungunya," "yellow fever," "epidemiology," "transmission," and "prevention."

Original studies, systematic reviews, meta-analyses, case reports, and clinical guidelines in English and Spanish were included. Publications that did not address biological, clinical, or epidemiological aspects of arboviruses were excluded, as were duplicates or those with restricted access to the full text.

The information collected was organized into the following thematic categories: biological characteristics of viruses, vectors, and transmission cycles; geographic distribution; clinical manifestations; diagnostic methods; treatment; prevention; and control.

The data were then analyzed descriptively and comparatively to identify current trends, knowledge gaps, and recommendations for clinical practice and public health.

RESULTS

Table 1. Medically important arboviruses, vectors, and geographic distribution

Virus	Family	Main vector	Geographic distribution
Dengue	Flaviviridae	Aedes aegypti, A. albopictus	Latin America, Southeast Asia, Africa
Zika	Flaviviridae	Aedes aegypti, A. albopictus	America, Africa, Asia
Chikungunya	Togaviridae	Aedes aegypti, A. albopictus	Africa, Asia, America
Yellow fever	Flaviviridae	Aedes, Haemagogus	Africa, South America
Tick-borne encephalitis	Flaviviridae / Bunyaviridae	Ixodidae ticks	Europe, Russia, Asia

Biological characteristics of viruses.

Arboviruses are characterized by single-stranded RNA genomes, generally of positive or negative polarity,

encapsulated in a lipid envelope that facilitates their entry into cells through receptor-mediated endocytosis processes.[12]

From a taxonomic point of view, arboviruses belong to different families, the most relevant being Flaviviridae (dengue virus, Zika virus, yellow fever virus), Togaviridae (chikungunya virus), Bunyaviridae (La Crosse encephalitis virus), and Reoviridae (Colorado hemorrhagic fever virus)[13,14] Despite their diversity, they share standard mechanisms of intracellular replication and biological transmission between vertebrates and arthropod vectors.[15]

Structure and genome

Arboviruses have an icosahedral or helical capsid surrounded by a lipid envelope derived from the host cell membrane.[16]

On the surface, viral glycoproteins are arranged to perform binding and fusion functions with the host membrane.[16]

The viral genome is usually single-stranded RNA, which encodes both structural proteins (capsid, envelope) and non-structural proteins (replication enzymes).[17]

Table 2. Structure and genome

Component	Description	Function
Capsid	Icosahedral or helical	Protects the genome
Lipid envelope	Derived from the host membrane	Interaction with the cell
Glycoproteins	Viral surface	Binding and fusion with host cell
RNA genome	Single strand, 10-12 kb	Encodes structural and non-structural proteins
Structural proteins	Capsid and envelope	Viral integrity
Non-structural proteins	Replication enzymes	Viral replication

Replication and biological cycle

The replication cycle begins with the virus binding to specific receptors on the vertebrate host or arthropod vector.[18] After entry, the viral RNA is either directly translated (in positive-strand RNA viruses) or transcribed into a complementary messenger RNA (in negative-strand RNA viruses).[18] Replication occurs in the cytoplasm, using both viral and cellular enzymatic machinery, generating new virions that are released by budding.[19]

In the vector, the infection is persistent and non-lethal, allowing effective transmission throughout its life. In the vertebrate host, viremia is transient and elicits an immune response that can be protective or pathogenic, depending on the arbovirus.[20]

Ecological and epidemiological factors: The replication of arboviruses in vectors depends on environmental temperature, humidity, and mosquito population density, factors that determine the rate of extrinsic incubation and the potential for transmission.[21] In tropical regions, Aedes aegypti is the primary vector for dengue, Zika, and chikungunya, favored by warm climatic conditions and inadequate urbanization.[22]

Clinical manifestations of arboviral diseases

Arboviruses share transmission routes but differ in clinical presentation and progression.[23] These infections can range from mild and self-limiting to severe forms with hemorrhagic, neurological, or multiorgan involvement, posing a diagnostic and therapeutic challenge in endemic regions.[24]

Dengue is caused by a virus with four variants: 1, 2, 3, and 4.[24]

Dengue is characterized by a clinical picture with two essential phases: in the first febrile phase, the patient presents with headache, high fever, myalgia, rash, and arthralgia (25). This is followed by the critical phase, in which warning signs, vomiting, severe abdominal pain, lethargy, and mild bleeding appear.[25]

Severe dengue is associated with plasma extravasation, severe hemorrhaging, and hypovolemic shock in critically ill patients.[26] The presence of comorbidities and co-infections can increase mortality, especially in pregnant women and children.[27]

Another important arbovirus in the region is Chikungunya, a viral disease caused by an alphavirus that presents with high fever and severe arthralgia that can be incapacitating. Unlike dengue, the febrile phase is accompanied by skin rashes, joint edema, and generalized myalgia.[28]

In some cases, arthritis can persist for weeks or months, constituting a chronic form of the disease that impacts patients' quality of life.[29]

The Zika virus, another regional arbovirus, causes mild symptoms characterized by low fever, maculopapular rash, non-purulent conjunctivitis, and joint pain.[30]

There have been few cases in the country over the last five years, unlike Brazil, which suffered the worst ravages.[31]

The Zika virus is a relevant and dangerous virus related to the effects it causes in the pregnant and neonatal populations, with neurological and congenital complications. Its association with Guillain-Barré syndrome and, in pregnant women, with congenital microcephaly and other neurological disorders in the fetus has been proven.[31] These complications have led to specific protocols for epidemiological surveillance and prenatal care in South American countries.[32]

Diagnostic methods and treatment of arboviruses

The diagnosis of arboviral diseases is a clinical and epidemiological challenge due to the overlap of symptoms between different viruses and other tropical febrile illnesses.[33] Confirmation of the etiological agent requires a combination of clinical evaluation and serological, molecular, and virological tests, depending on the stage of the disease.[34]

Diagnostic methods

During the acute phase (0–5 days after symptom onset), diagnosis is preferably based on direct detection of the virus using molecular techniques such as reverse transcription polymerase chain reaction (RT-PCR), which allows dengue, Zika, and chikungunya viruses to be identified and differentiated with high sensitivity.[35] This technique also enables the monitoring of outbreaks and the characterization of circulating genotypes.[36]

In the convalescent phase (from the fifth day onward), when viremia decreases, serological tests such as ELISA for IgM and IgG antibodies are used. The presence of specific IgM indicates recent infection, while an increase in IgG in paired samples suggests past or secondary infection.[37] However, cross-reactivity between flaviviruses can yield false positives, necessitating confirmation with plaque reduction neutralization tests (PRNT) or complementary molecular tests.[38]

Differential diagnosis is key to distinguishing arboviruses from other endemic diseases, such as malaria, leptospirosis, or typhoid fever.[39] In resource-limited settings, the implementation of combined clinical-laboratory algorithms has been shown to improve diagnostic sensitivity and reduce underreporting of cases.[40]

Treatment

Currently, there is no specific antiviral treatment for most arboviral diseases; therefore, management is symptomatic and supportive, aimed at controlling fever, preventing dehydration, and monitoring for warning signs.[41] For dengue, adequate hydration with isotonic solutions, fever control with paracetamol, and strict clinical monitoring are recommended; nonsteroidal anti-inflammatory drugs should be avoided due to the risk of bleeding.[42]

In the case of chikungunya, treatment is based on analgesics and anti-inflammatory drugs under medical supervision, as arthralgia can persist for weeks or months. Immunomodulatory therapies have been explored in chronic cases, but there is no conclusive evidence.[43]

For Zika, management includes rest, hydration, and symptomatic control. In pregnant women with suspected Zika infection, monthly ultrasound monitoring and fetal neurological evaluation are recommended, according to the guidelines of the Pan American Health Organization.[44]

Prevention remains the primary therapeutic tool.[45] Vector control, strengthening surveillance systems, and health education are essential pillars in reducing morbidity and mortality.

Table 3. Clinical manifestations and associated complications

Virus	Common symptoms	Serious complications
Dengue	Fever, headache, muscle pain	Severe dengue with hemorrhage and shock
Zika	Mild fever, rash, arthralgia	Microcephaly in newborns, Guillain-Barré syndrome
Chikungunya	Fever, severe joint pain	Chronic arthritis, neurological complications
Yellow fever	Fever, jaundice, myalgia	Liver failure, hemorrhage
Tick-borne encephalitis	Fever, headache, vomiting	Encephalitis, paralysis, death

Complications and atypical forms of arbovirus diseases.

Although most arbovirus infections cause mild or moderate symptoms, a subgroup of patients develops serious complications or atypical forms that can compromise multiple organs and systems, increasing morbidity and mortality.[45] These complications depend on factors such as age, comorbidities, coinfection by more than one virus, and the host's immune response.[46]

Hemorrhagic complications and shock

Severe dengue can progress to dengue shock syndrome, severe hemorrhage, and multiple organ failure.[47]

Massive plasma loss and severe thrombocytopenia are critical factors that require immediate hospital management and close monitoring.[47]

Gastrointestinal, nasal, and skin hemorrhages are the most common manifestations, while cardiovascular complications are less common but serious.[48]

Neurological complications

Zika and chikungunya can cause involvement of the central and peripheral nervous systems. Cases of Guillain-Barré syndrome, encephalitis, meningoencephalitis, and seizures have been reported [49] in both adults and congenitally infected newborns.[50] Congenital Zika infection is associated with microcephaly, intracranial calcifications, and neurodevelopmental delay, constituting a significant public health problem.[51]

Musculoskeletal and joint complications

In the case of chikungunya, chronic arthralgia and arthritis represent the most significant long-term complications, causing functional disability and a reduced quality of life [52] in a substantial percentage of patients.[53] Joint pain can persist for months or even years after an acute infection.

Hepatic, renal, and cardiovascular complications

Cases of acute hepatitis, elevated transaminases, acute renal failure, and myocarditis have been documented, especially in patients with severe dengue or viral co-infections. These complications, although less frequent, can be fatal if not detected and managed promptly.[54]

Atypical forms and coinfections

Atypical forms include prolonged fever, unusual skin manifestations, severe thrombocytopenia without obvious bleeding, and isolated neurological involvement.[54] Coinfections with more than one arbovirus (e.g., dengue + chikungunya) complicate the clinical picture, increase the likelihood of warning signs, and make differential diagnosis difficult.[55]

Table 4. Diagnosis, prevention, and control of arboviral diseases

Virus	Diagnosis	Prevention and control
Dengue	Serology, PCR	Vector control, vaccination (endemic countries)
Zika	PCR, IgM	Vector control, protection during pregnancy
Chikungunya	PCR, serology	Vector control
Yellow fever	PCR, serology, virus isolated	Vaccination, vector control
Tick-borne encephalitis	Serology, PCR, viral isolation	Avoid tick bites, vaccination in risk areas

Prevention and control of arboviruses

The control and prevention of arboviral diseases is an essential pillar of public health, given that specific treatment for most of these viruses is limited or non-existent.[42] Strategies are based on vector control, health education, epidemiological surveillance, and vaccination when available.

Vector control

Controlling mosquitoes of the genus Aedes, the primary vector for dengue, Zika, and chikungunya, is the most effective strategy. Recommended measures include eliminating breeding sites of stagnant water in homes and public spaces by conducting house-to-house visits.[43]

Using insecticides with residual and biological effects in areas with high vector density to prevent the proliferation of vectors.[43] Applying larvicides to permanent water deposits in the community, encouraging the population to use physical barriers such as mosquito nets, and protective clothing such as long pants, long-sleeved shirts, and closed shoes.[44]

In addition, integrated vector control, which combines chemical, biological, physical, and community interventions, has proven to be more effective than isolated strategies.[45]

Health education and community participation: active involvement is essential to reduce vector proliferation. Educational programs should teach the general population to identify domestic breeding sites in empty

containers scattered around the yard and in stagnant water and to use repellents to prevent mosquito bites.[46] Disseminate accurate information to the community at large in schools, colleges, and health centers about warning signs and reasons for early medical consultation to avoid complications.[47]

Epidemiological surveillance

Epidemiological surveillance can detect outbreaks, identify circulating serotypes, and guide health interventions. Therefore, entomological monitoring is recommended for the general population to assess vector density and transmission risk.[48]

Continue clinical and laboratory surveillance to identify suspected and confirmed cases of arbovirus infection[49] and conduct continuous data recording and analysis to predict outbreaks and plan interventions.[50]

Vaccination: currently, the available vaccines are limited: Dengvaxia® for dengue in previously infected individuals and residents of endemic areas.[51] Vaccines for Zika and chikungunya are under development, primarily in the early clinical phases.[52]

Vaccination should be integrated with vector control strategies and health education, as no vaccine offers universal or permanent immunity.[53]

Additional measures: use of repellents and clothing that covers most of the body.[45] Management of natural breeding sites in urban and peri-urban areas. Inter-institutional coordination between public health, education, and the environment for program sustainability.[48]

DISCUSSION

The review shows that arboviruses remain a global threat due to the expansion of their vector populations and increasing human mobility.[1,2] Dengue and Zika are the most widespread viruses in Latin America, associated with recurrent epidemic outbreaks, while chikungunya has shown regional emergencies with high joint morbidity.[3,4]

The neurological complications of Zika, such as microcephaly and Guillain-Barré syndrome, underscore the need for epidemiological surveillance and specific health education for vulnerable populations, especially pregnant women.[5] Yellow fever, although preventable through effective vaccination, continues to cause outbreaks in tropical areas of Africa and South America, reflecting gaps in vaccination coverage and vector control.[6]

Timely diagnosis using molecular and serological techniques is crucial for differentiating arbovirus infections with overlapping symptoms and for implementing rapid containment measures.[7] Prevention focuses primarily on vector control, repellent use, community education, and vaccination where available. However, the lack of specific antivirals limits treatment options, underscoring the importance of research to develop effective antiviral therapies.[8,9]

In conclusion, this review highlights the need to strengthen epidemiological surveillance, promote applied research, and improve prevention strategies to reduce the burden of arbovirus-associated disease worldwide.[10]

Geographic distribution, vectors, and arboviruses

The global expansion of arboviruses transmitted by Aedes aegypti and Aedes albopictus, such as dengue, Zika, chikungunya, and yellow fever, has been documented in various urban and peri-urban regions. A recent study indicates that approximately 5,66 billion people live in areas suitable for the transmission of these viruses, with significant overlap in the risk areas for dengue, Zika, and chikungunya. This geographic convergence underscores the need for integrated, coordinated vector control strategies at the global level.

Clinical manifestations and complications

Arbovirus infections present a wide range of clinical manifestations, from asymptomatic forms to severe cases. For example, up to 75 % of dengue cases and 80 % of Zika cases may be asymptomatic.

- Neurological complications, such as encephalitis and Guillain-Barré syndrome, have been reported in cases of Zika and chikungunya
- These complications underscore the importance of comprehensive clinical surveillance and rapid case identification to implement appropriate therapeutic measures.

Diagnosis, prevention, and control

The diagnosis of arbovirus infections is based on serological and molecular techniques, although co-infection and similar clinical presentation among these viruses can make accurate identification difficult

- In terms of prevention, vector control through the elimination of breeding sites, the use of repellents, and the implementation of vaccination programs are essential. The introduction of innovative strategies, such as the use of Wolbachia bacteria to reduce the vector capacity of Aedes, has shown promising results in field studies.

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CONFLICT OF INTEREST

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