encephalitis viruses are discussed here as encephalitides, but during epidemics many patients present with much milder febrile syndromes. Similarly, Rift Valley fever virus is best known as a cause of VHF, but the attack rates for febrile disease are far higher, and encephalitis and blindness occasionally occur as well. Lymphocytic choriomeningitis virus is classified here as a cause of fever and myalgia because this syndrome is the most common disease manifestation; even when central nervous system (CNS) disease evolves during infection with this virus, neural manifestations are usually mild and are preceded by fever and myalgia. Infection with any dengue virus type (1, 2, 3, or 4) is considered as a cause of fever and myalgia because this syndrome is by far the most common manifestation worldwide. However, severe dengue is a VHF with a complicated pathogenesis that is of tremendous importance in pediatric practice in certain areas of the world. Unfortunately, most of the known arthropod- or rodent-borne viral diseases have not been studied in detail with modern medical approaches; thus available data may be incomplete or biased. The reader must be aware that data on geographic distribution are often fuzzy: the literature frequently is not clear as to whether the data pertain to the distribution of a particular virus or the areas where human disease has been observed. In addition, the designations for viruses and viral diseases have changed multiple times over decades. Here, virus and taxon names are in line with the latest reports of the International Committee on Taxonomy of Viruses, and disease names are largely in accordance with the World Health Organization's International Classification of Disease version 10 (ICD-10) and more recent updates.

ARTHRITIS AND RASH

Arthritides are common accompaniments of several viral diseases, such as hepatitis B, parvovirus B19 infection, and rubella, and occasionally accompany infection due to adenoviruses, enteroviruses, herpesviruses, and mumps virus. Two ungrouped bunyaviruses, Gan Gan virus and Trubanaman virus, and the flavivirus Kokobera virus have been associated with single cases of polyarthritic disease. Arthropod-borne alphaviruses are also common causes of arthritides—usually acute febrile diseases accompanied by the development of a maculopapular rash. Rheumatic involvement includes arthralgia alone, periarticular swelling, and (less commonly) joint effusions. Most alphavirus infections are less severe and have fewer articular manifestations in children than in adults. In temperate climates, these ailments are summer diseases. No specific therapies or licensed vaccines exist. The most important alphavirus arthritides are Barmah Forest virus infection, chikungunya virus disease, Ross River disease, and Sindbis virus infection. A large (>2 million cases), albeit isolated, epidemic was caused by o'nyong nyong virus in 1959–1961 (o'nyong nyong fever). Mayaro, Semliki Forest, and Una viruses have caused isolated cases or limited and infrequent epidemics (30 to several hundred cases per year) in the past. Signs and symptoms of infections with these viruses often are similar to those observed with chikungunya virus disease.

Chikungunya Virus Disease Disease caused by chikungunya virus is endemic in rural areas of Africa. Intermittent epidemics take place in towns and cities of both Africa and Asia. *Aedes aegypti* mosquitoes are the usual vectors for the disease in urban areas. In 2004, a massive epidemic began in the Indian Ocean region (in particular on the islands of Réunion and Mauritius) and was most likely spread by travelers; *Aedes albopictus* was identified as the major vector of chikungunya virus during that epidemic. Between 2013 and 2014, several thousand chikungunya virus infections were reported (and several tens of thousands of cases were suspected) from Caribbean islands. The virus was imported to Italy, France, and the United States by travelers from the Caribbean. Chikungunya virus poses a threat to the continental United States as suitable vector mosquitoes are present in the southern states. The disease is most common among adults, in whom the clinical presentation may be dramatic. The abrupt onset of chikungunya virus disease follows an incubation period of 2–10 days. Fever (often severe) with a saddleback pattern and severe arthralgia are accompanied by chills and constitutional symptoms and signs, such as abdominal pain, anorexia, conjunctival injection, headache, nausea, and photophobia. Migratory polyarthritis mainly affects the small joints of the ankles, feet, hands, and wrists, but the larger joints are not necessarily spared. Rash may appear at the outset or several days into the illness; its development often coincides with defervescence, which occurs around day 2 or 3 of the disease. The rash is most intense on the trunk and limbs and may desquamate. Young children develop less prominent signs and are therefore less frequently hospitalized. Children also often develop a bullous rather than a maculopapular/petechial rash. Maternal–fetal transmission has been reported and in some cases has led to fetal death. Recovery may require weeks, and some elderly patients may continue to experience joint pain, recurrent effusions, or stiffness for several years. This persistence of signs and symptoms may be especially common in HLA-B27-positive patients. In addition to arthritis, petechiae are occasionally seen and epistaxis is not uncommon, but chikungunya virus should not be considered a VHF agent. A few patients develop leukopenia. Elevated concentrations of aspartate aminotransferase (AST) and C-reactive protein have been described, as have mildly decreased platelet counts. Treatment of chikungunya virus disease relies on nonsteroidal anti-inflammatory drugs and sometimes chloroquine for refractory arthritis.

Barmah Forest Virus Infection and Ross River Disease Barmah Forest virus and Ross River virus cause diseases that are indistinguishable on clinical grounds alone (hence the previously common disease designation *epidemic polyarthritis* for both infections). Ross River virus has caused epidemics in Australia, Papua New Guinea, and the South Pacific since the beginning of the twentieth century and continues to be responsible for ~4800 cases of disease in rural and suburban areas annually. In 1979–1980, the virus swept through the Pacific Islands, causing more than 500,000 infections. Ross River virus is predominantly transmitted by *Aedes normanensis*, *Aedes vigilax*, and *Culex annulirostris*. Wallabies and rodents are probably the main vertebrate hosts. Barmah Forest virus infections have been on the rise in recent years. In 2005–2006, roughly 2000 cases were recorded in Australia. Barmah Forest virus is transmitted by both *Aedes* and *Culex* mosquitoes and has been isolated from biting midges. The vertebrate hosts remain to be determined, but serologic studies implicate horses and possums.

Of the human Barmah Forest and Ross River virus infections surveyed, 55–75% were asymptomatic; however, these viral diseases can be debilitating. The incubation period is 7–9 days; the onset of illness is sudden, and disease is usually ushered in by disabling symmetrical joint pain. A nonitchy, diffuse, maculopapular rash (more common in Barmah Forest virus infection) generally develops coincidentally or follows shortly, but in some patients it can precede joint pains by several days. Constitutional symptoms such as low-grade fever, asthenia, headache, myalgia, and nausea are not prominent or are absent in many patients. Most patients are incapacitated for considerable periods (≥6 months) by joint involvement, which interferes with grasping, sleeping, and walking. Ankle, interphalangeal, knee, metacarpophalangeal, and wrist joints are most often involved, although elbows, shoulders, and toes may also be affected. Periarticular swelling and tenosynovitis are common, and one-third of patients have true arthritis (more common in Ross River disease). Myalgia and nuchal stiffness may accompany joint pains. Only half of all patients with arthritis can resume normal activities within 4 weeks, and 10% still must limit their activity after 3 months. Occasional patients are symptomatic for 1–3 years but without progressive arthropathy.

In the diagnosis of either infection, clinical laboratory values are normal or variable. Tests for rheumatoid factor and antinuclear antibodies are negative, and the erythrocyte sedimentation rate is acutely elevated. Joint fluid contains 1000–60,000 mononuclear cells/μL, and viral antigen can usually be detected in macrophages. IgM antibodies are valuable in the diagnosis of this infection, although such antibodies occasionally persist for years. Isolation of the virus from blood after mosquito inoculation or growth of the virus in cell culture is possible early in the illness. Because of the great economic impact of annual epidemics in Australia, an inactivated Ross River virus vaccine is under development. Nonsteroidal anti-inflammatory drugs such as naproxen or acetylsalicylic acid are effective for treatment.