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Dr. Arun Prakash
Associate Professor, Department of Roga Nidana Evam Vikriti Vigyana, Sri Sairam Ayurveda Medical College and Research Centre, Chennai, Tamil Nadu, India

Dr. S Dhruva Prasad
Assistant Professor, Department of Swastha Vritta & Yoga, Sri Sri College of Ayurvedic Science & Research Hospital, Sri Sri University, Cuttack, Odisha, India

Dr. Ajay Kumar Tripathi
Senior Ayurvedic Medical Officer, Government of West Bengal Health Service, West Bengal, India

Dr. Dhaval P Makwana
Associate Professor, Indian institute of Ayurveda Research & Hospital, Rajkot, Gujarat, India

Dr. Udhaya Shankar T
Associate Professor, Department of Agad Tantra evam Vidhi Vaidyaka, Rama Ayurvedic Medical College and Hospital, Rama University, Kanpur, Uttar Pradesh, India

Corresponding Author:
Dr. Arun Prakash
Associate Professor, Department of Roga Nidana Evam Vikriti Vigyana, Sri Sairam Ayurveda Medical College and Research Centre, Chennai, Tamil Nadu, India

Understanding and resolving the progress obstacles of Japanese encephalitis

Dr. Arun Prakash, Dr. S Dhruva Prasad, Dr. Ajay Kumar Tripathi, Dr. Dhaval P Makwana and Dr. Udhaya Shankar T

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Abstract
Japanese Encephalitis (JE) is a renowned life-threatening viral disease caused by none other than the Japanese Encephalitis Virus (JEV), a member of the FLAVIVIRIDAE family. The symptoms may include fever, headache, seizures, disorientation and sometimes coma. Although symptomatic cases of Japanese encephalitis are rare, the disease has a high fatality rate of up to 30% and at least 30 to 50% of survivors suffer with permanent neurological damage and yet around 10 to 20% of those affected may experience only mild symptoms. The *Culex* mosquito is the primary vector responsible for transmitting the virus. JE is endemic in several Indian states, including Uttar Pradesh, Bihar, West Bengal and Assam. This review article aims to provide a comprehensive overview of Japanese Encephalitis, its progression and the challenges associated with its treatment.

Keywords: *Culex* mosquito, Japanese encephalitis, vector-borne diseases

Introduction
The Japanese Encephalitis Virus (JEV) causes a deadly disease called Japanese Encephalitis (JE), which is transmitted between animals and humans by *Culex* mosquitoes. JEV is a single-stranded RNA virus with a nucleocapsid surrounded by a glycoprotein envelope and it contains 3 structural and 7 non-structural proteins [1].

JE is a major public health concern that can be fatal, with a case fatality rate reaching up to 30% among symptomatic individuals. The infection manifests in a spectrum of clinical symptoms, beginning with flu-like signs, stiffness of neck and disorientation and can progress to coma, seizures, spastic paralysis and finally death. JE is responsible for numerous deaths and often leads to severe neuro-psychiatric complications that can potentially necessitate a lifelong care, imposing a significant socioeconomic burden [2]. JE primarily affects children in endemic regions but in newly affected areas, it can impact both adults and children. In certain regions of Northern India, Nepal and Sri Lanka, all age groups are vulnerable to the disease and the highest age-specific attack rates are observed in children between 3 and 6 years of age [3].

There is no specific antiviral treatment for JE and the management is limited only to supportive care and vaccination remains the sole prophylactic intervention for achieving immunity against the disease, offering both safety and efficacy beyond the preventive measures like mosquito bite avoidance [4]. JE is predominantly endemic to East and Southeast Asia, as well as the Western Pacific region, affecting approximately 3 billion individuals residing in these areas and annually, an estimated 68,000 symptomatic cases are reported, resulting in approximately 17,000 fatalities [5].

Pathogenesis
JEV is a flavivirus characterized by a single-stranded RNA genome. This genomic sequence encodes three structural proteins - capsid, membrane/premembrane and envelope proteins; and seven non-structural proteins, specifically NS1, NS2A, NS2B, NS3, NS4A, NS4B and NS5. Upon infecting a host cell, the JEV releases its genomic RNA into the cytoplasm, initiating translation via the host's cellular machinery to produce a polyprotein.

This polyprotein undergoes proteolytic cleavage by both host and viral proteases, subsequently facilitating the replication of the JEV genome. The structural proteins are incorporated into the virion particles, whereas the non-structural proteins play the essential part of formation of the Replication Complex (RC) and Assembly Complex (AC), as well as for the replication of the viral genomic RNA. Prior to egress from the host cell, the newly assembled virions must undergo a maturation process, which is facilitated by progressive reductions in pH within various host cell organelles. The endoplasmic reticulum (ER) lumen, with a pH of 6.7, serves as an optimal environment for the packaging and assembly of viral particles. The immature virion undergoes budding and fuses with ER-derived vesicles, which then transport it to the Cis-Golgi Network (CGN) where the pH is 6.0 and subsequently to the Trans-Golgi Network (TGN) with a pH of 5.7. The decrease in pH triggers the cleavage of the prM protein by the host furin protease into its pr and M subunits, facilitating the maturation of the Japanese Encephalitis Virus (JEV) virion prior to its release from the host cell [6, 7].

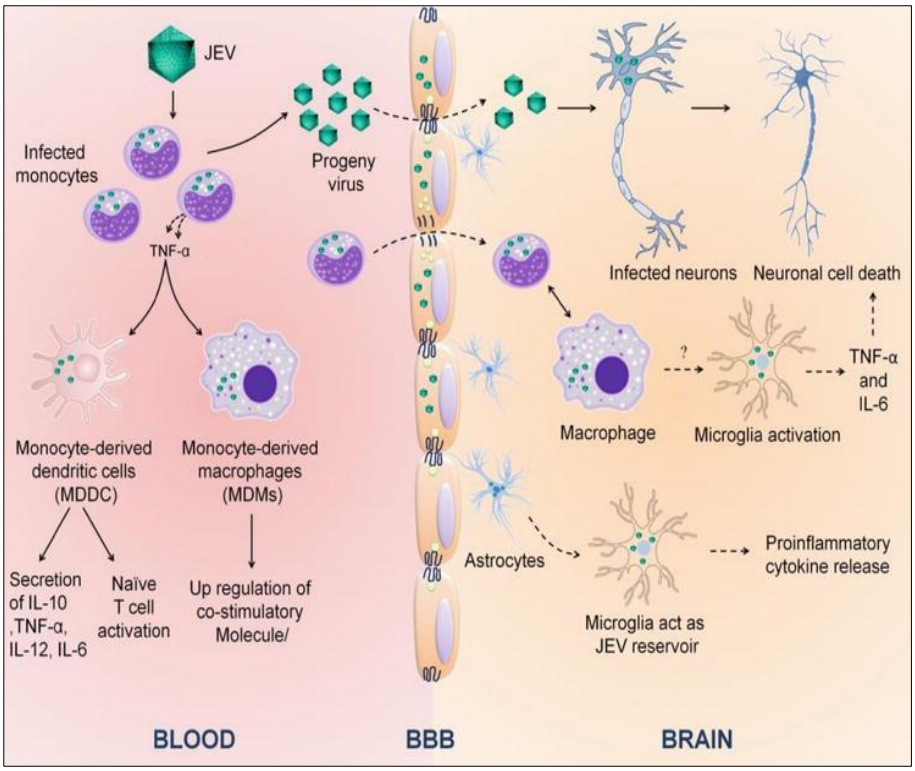

Fig 1: Pathogenesis of Japanese Encephalitis

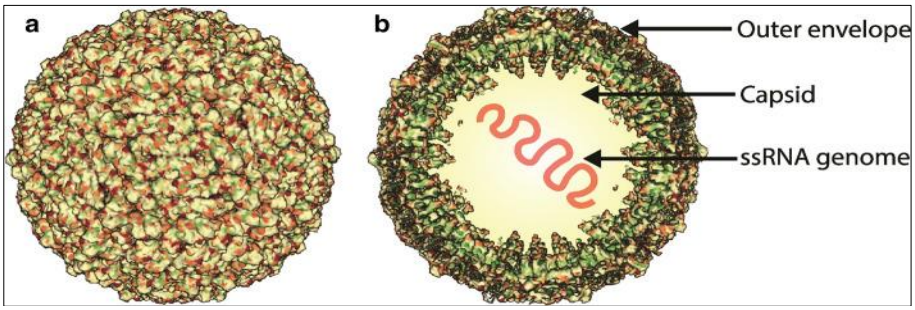

Fig 2: Structure of JEV [8]

Table 1: Symptoms of Japanese encephalitis

Mild symptoms	Serious symptoms
Fever	Acute encephalitis
Headache	Seizure
Nausea or Vomiting	Cachexia
Muscle ache	Coma
Generalised weakness	Hemiparesis
Rigors	Death

Most infections are asymptomatic, with a subset presenting mild symptoms as previously described and approximately 1 in 250 cases progress to encephalitis, which can ultimately result in a fatal outcome [9].

Incubation period: 2 to 26 days.

Diagnosis: Diagnosis is achieved through the detection of

IgM antibodies in serum or cerebrospinal fluid. JEV can be identified 3 to 8 days post-infection, with antibodies potentially remaining detectable for 30 to 90 days. IgM may not be detectable if samples are collected within the first 10 days of illness. Testing performed later may reflect past infection or vaccination and it is recommended to repeat the test using a convalescent sample for accurate diagnosis [10].

Different obstacles of Japanese encephalitis

1. **Vector control:** Implementing strategies to manage mosquito populations is crucial for the prevention and control of JEV transmission.
2. **Personal protection:** Measures such as the use of mosquito nets and insect repellents are essential for reducing individual exposure to mosquitoes.
3. **Awareness Programs and Health Education:** Providing comprehensive health advice and education regarding vector-borne diseases can enhance public knowledge and contribute to decreased mosquito exposure [11].

Treatment

Vaccine is most effective one for JE

1. **Medication:** Early administration of medications can be effective for managing mild symptoms such as fever, headache and vomiting.
2. **Supportive care:** For moderate cases, which may include symptoms such as muscle aches, general weakness and mild febrile seizures, supportive care is recommended.
3. **Fluid management:** Adequate hydration is critical for severe cases presenting with high fever and persistent vomiting.
4. **Hospitalization:** Severe cases, including those with neurological manifestations, convulsions or coma, typically require hospitalization for intensive medical management [12].

References

1. Misra UK, Kalita J. Overview: Japanese encephalitis. J Indian Acad Clin Med. 2010;91(2):108-120.
2. Solomon T. Control of Japanese encephalitis--within our grasp? N Engl J Med. 2006;355(9):869-871.
3. Misra UK, Kalita J. Overview: Japanese encephalitis. J Indian Acad Clin Med. 2010;91(2):108-120.
4. World Health Organization (WHO). Japanese encephalitis [Internet]. December 2015. Archived from the original on 13 July 2017. Available from: https://www.who.int/news-room/fact-sheets/detail/japanese-encephalitis
5. Centers for Disease Control and Prevention (CDC). Symptoms and Treatment [Internet]. August 2015. Archived from the original on 17 June 2017. Available from: https://www.cdc.gov/japaneseencephalitis/symptoms.html
6. Yun SI, Lee YM. Early events in Japanese encephalitis virus infection: viral entry. Pathogens. 2018;7:68. doi: 10.3390/pathogens7020068.
7. Kumar S, Verma A, Yadav P, Dubey SK, Azhar EI, Maitra SS, Dwivedi VD. Molecular pathogenesis of Japanese encephalitis and possible therapeutic strategies. Arch Virol. 2022 Sep;167(9):1739-1762. doi: 10.1007/s00705-022-05476-2.
8. David SS, Mandar B, Radka D, *et al*. Mol* Viewer: modern web app for 3D visualization and analysis of large biomolecular structures. Nucleic Acids Res. 2021;49(W1). doi: 10.1093/nar/gkab314.
9. Davey M. What is Japanese encephalitis and why is it spreading in Australia? [Internet]. The Guardian Australia. March 2022. [cited 2022 Oct 20]. Available from: https://www.theguardian.com/australia-news/2022/mar/12/japanese-encephalitis-australia
10. Shrivastva A, Tripathi NK, Parida M, Dash PK, Jana AM, Lakshmana Rao PV. Comparison of a dipstick enzyme-linked immunosorbent assay with commercial assays for detection of Japanese encephalitis virus-specific IgM antibodies. J Postgrad Med. 2008;54(3):181-5.
11. National Centre for Vector Borne Diseases Control (NCVBDC). Vector Control: Mosquito control [Internet]. [cited 2024 Sep 10]. Available from: https://ncvbdc.mohfw.gov.in/index1.php?lang=1&level=2&sublinkid=5930&lid=4005
12. National Centre for Vector Borne Diseases Control (NCVBDC). Vector Control: Mosquito control [Internet]. [cited 2024 Sep 10]. Available from: https://ncvbdc.mohfw.gov.in/index1.php?lang=1&level=2&sublinkid=5930&lid=4005