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Usage of Novel Analytical Techniques for Treatment of Jamestown Canyon Virus (JCV) Disease-A Review

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Abstract

Jamestown Canyon Virus (JCV) is a vector-borne disease that spreads from the bite of an infected Mosquito to humans and resembles the dengue virus in its transmission mode. This disease is rampant in Upper Midwest regions of the US and some provinces of Canada.

Research done previously suggests that the clinical diagnosis of the disease can be accomplished by testing the serum isolated from the blood of patients who test positive for the virus.

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Real-time RT PCR, a rapid molecular detection test, is still being investigated for its usage in the diagnosing JCV. There are different types of Mosquitoes, namely the Snowmelt Aedes mosquito, a known reservoir of the JCV. But some research studies suggest that RT-PCR could be used primarily to diagnose and survey the cocirculation of the JCV or LACV to the epidemiologists and health policymakers for informed public action.

Keywords: JCV; Pathogenesis; IgM-JCV specific Ab; Differential diagnosis; Arboviral therapy; PRNT test; Serology; Droplet digital PCR; Isothermal PCR.

Introduction

Background information on JCV

Jamestown Canyon Virus (JCV) is a vectorborne disease that spreads from the bite of an infected Mosquito to the humans and resembles the dengue virus in its transmission [1] mode.

Importance of JCV

Health agencies such as WHO and CDC consider this virus as less important as not much information or study is done about the pathogenesis and treatment strategies for JCV [2].

Objectives of the review

The review article aims to identify and mainly highlight the possible treatment strategies for JCV that any health agency worldwide can adopt into the healthcare system. Most of the information used for this review article can possibly include some already existing information from CDC website that can be briefly summarized here.

Biology and epidemiology of JCV

General features of the virus

The virus belongs to a family of bunyaviruses closely resembling the La Crosse Virus [3]. The host JCV inhabits deer, and other animals harbor the virus in the inactive form, and once the Snowmelt Aedes mosquito gets infected with the active form of the virus, they go on to infect humans. Most of the patients who get infected with the virus experience no symptoms or are asymptomatic, although some cases of fever, encephalitis [4] and death are prevalent [5].

Viral replication and pathogenesis

In order to better understand the viral replication and pathogenesis of this virus, the mechanism of replication for La Crosse Virus [3] needs to be understood as it has a similar pattern to JCV due to it being a neuro invasive disease [5]. This disease is difficult to diagnose as there is cross-reactivity with other arboviruses [6], and many mosquito vectors harbor this virus.

Natural history and transmission of JCV

The timeline of when JCV began, according to research, is 1961 from infected mosquitoes at Jamestown Canyon, Colorado hence the name. It is quite like H₁N₁ swine flu influenza, as it spreads from animals to humans, but the female Aedes snowmelt mosquito is the one that spreads the disease to humans by feeding on infected deer's blood during spring to summer.

This disease can occur anytime from spring through fall, and the genome consists of a single-stranded enveloped RNA virus with three partial genes [7].

Geographic distribution of the virus

It started in Colorado and spread slowly across the United States and is also present in some provinces of Canada. Most of it is concentrated around the Upper Midwest states of the US. Some cases have recently been observed in the United Kingdom, especially parts of England and Scotland [7].

Clinical presentation and diagnosis of JCV

Serological testing is the primary method to diagnose Jamestown Canyon Virus disease. The serum is isolated from the blood of patients testing positive for the virus purely for diagnosis and also to check if any IgMspecific Ab has developed due to exposure to the virus. Based on IgM-JCV-specific Ab, a clinically sounder diagnosis of the disease can be made.

Symptoms and signs of JCV infection

Some of the common signs and symptoms of JCV include fever, general tiredness, headache, and sometimes even nausea, runny nose, or itchy throat.

Differential diagnosis of JCV

Differential diagnosis should be taken by the consideration of clinicians only if the arboviral illness is expected to be arising out of febrile neurologic infection, however

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testing for West Nile [8] Virus does not yield any further results or it is inconclusive.

There is a lot of potential for improved diagnosis and surveillance of arboviral infections that could help the clinicians in making decisions related to better patientcare and management decisions towards epidemiologists making better choices for informing the public and preventive measures that are required to be taken [7].

Laboratory diagnosis of Jamestown canyon virus

Serology (The branch of Biology dealing with fluids like serum) is the main area of diagnosis using JCV-specific Immunoglobulin Type-M test subsequently followed by PRNT test.

To predict the number of Antibodies, present in positive individuals is difficult as most of them get infected without any symptoms except a few cases which is difficult to track and requires proper diagnostic tools for efficient administration by public health officials.

Management of JCV infection

JCV infection management is not easy as there are many varieties of Mosquitoes from Spring to Fall that have this virus harbored inside them in the inactive stage of development.

Also, the task of making vaccines against JCV is a herculean task as we have to study the genomes of the primary host (deer, reindeer or any of the herbivores) [9] including of 1000's of species of Mosquitoes that act as intermediary hosts and pass on the virus to humans and therefore could take decades to develop a vaccine against the infection [10]. For now, to manage the infection it is best to do genomic surveillance for tracking, testing, diagnosing and preventing the disease as it is considered very effective.

Supportive care

Those who suffer from serious complications of the illness need hospitalized care in the form of Arboviral therapy such as a combined administration of Remdesivir/Any other antiviral along with Monoclonal Antibody therapy as it is found to be very effective in treating JCV with reference to certain literature [5].

Antiviral therapy

Initially, it was suggested by CDC that no antiviral treatment exists for JCV, but recently there is research going on suggesting that this virus can be cured by administering Antiviral therapy in the form of oral pills and still research is being done on the possibility of vaccines for JCV which may come out and become accessible to the public in the near future and prevent spread of infection although this virus has a low mortality rate killing only those who are immunodeficient due to certain conditions like cancer, diabetes, SCID, Parkinson's disease, etc. to name a few.

Prevention and maintenance

Since there is no vaccine for this virus, therefore it would be better to prevent this virus by eating fruits with Vitamins, taking Probiotic foods (good for long-term health according to scientific literature), drinking plenty of fluids, and also doing exercises as they provide defense against the pathogens that harm the body's immune system.

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Preventing pools of water from accumulating near the flower pots, bird pools, or on the road or nearby localities adjacent to the residential neighborhoods is to be adopted as a healthcare precaution to prevent the breeding of mosquitoes to produce young larvae that develop into adults and transmit disease carrying pathogen from an infected animal to human and also to prevent the spread of disease from an infected individual to a healthy person [2].

Public health implications of JCV

As such, this disease does not cause much damage to public health infrastructure but due to climate change, there is a threat of new diseases from different species of Mosquitoes [11] that could infect humans in the near future due to greenhouse gas emissions, according to literature provided by United Intergovernmental Nation's agency on Climate Change if appropriate actions are not taken to control the greenhouse emissions and reducing carbon footprint could possibly be the means to prevent any catastrophe to humans [12].

There is a likelihood of this disease undergoing becoming more of an epidemic and infecting human of all ages and causing serious complications if present diagnostic tools are not upgraded and also it is important for novel diagnostic techniques such as using Isothermal PCR, or droplet digital PCR (Droplet here involves taking a sample of biological fluid containing the virus and then feeding it to a disk that would send the digital information from which the PCR results can be analyzed is one such novel analytical method) [5]. The burden would be more for poor, developing countries with poorly equipped healthcare systems to prevent or treat the disease properly or could be for communities existing in developed countries.

Outbreaks and emergence

An outbreak of this disease could likely arise out of Canada and US where the risk of climate change leading to less frosty days and more warm conditions accompanied by unusual rainfall patterns could lead to increased number of variants of the disease therefore leading to more areas in the world that could become potential hotspots from where Jamestown Canyon virus disease could arise from [13,14].

Public health strategies for JCV prevention and control

The strategies taken by public health officials for JCV prevention could be to advise the public to erect mosquito nets near the Windows and doors to prevent mosquitoes from entering the homes, spraying disinfectants such as DEET, or DDT or any others to prevent mosquito breeding including the regular cleaning of swimming pools, bird pools, and flower pots, and prevention of puddles or pools of water from accumulating near neighborhoods or landfills where they could serve as potential breeding grounds for mosquitoes [2].

Discussion

This review article was solely written on the basis of understanding the mechanism of the JCV disease and the novel analytical techniques that could be used in the near future to prevent any possible outbreak of Jamestown Canyon Virus [15,16] and to solely

Burden of disease

inform the public as to what actions to take in case the virus spreads in the community. The novel diagnostic techniques used would be very useful for scientists to explore for future research purposes, not just for JCV but also for other viruses that can become zoonotic, i.e., transmit from animals to humans.

Conclusion

This review article has served its purpose of highlighting Jamestown Canyon Virus, a serious, fatal vector-borne disease spread by different species of Mosquitoes and also more about the novel diagnostic techniques that can be useful in curing and preventing this disease. JCV needs to be seriously addressed because it can have serious health implications for society in the future if preventive actions to eliminate this disease are not addressed well in hand. There are different types of Mosquitoes, namely the Snowmelt Aedes mosquito, a known reservoir of JCV. But some research studies suggest that RT-PCR could be used primarily to diagnose and survey the co-circulation of JCV or LACV to epidemiologists and health policymakers

for informed public action. But, not just RT-PCR, there are also many more novel ways for diagnosis of JCV (highlighted in this review study) that scientists and future researchers could identify in order to enable better public health action to prevent such diseases from spreading in the community and to protect the most vulnerable population from getting the serious complications due to this disease.

There could be new vaccines available by the end of the decade for the most vulnerable section of the population, mainly the immunocompromised population in every part and corner of the globe.

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