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Human Metapneumovirus: A Key Virus in Respiratory Infections - A Review Article

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ABSTRACT

Acute respiratory infections (ARIs) are a serious public health concern across the world, causing considerable morbidity and mortality. Every year, around 13 million children under the age of five die. Human Metapneumovirus (hMPV) is one of the causative agents associated with respiratory tract infections. it has been described as one of the main etiological agents that causes acute lower respiratory tract infections (ALRTIs), which is characterized by symptoms such as bronchiolitis, wheezing and coughing.

Keywords: Acute respiratory infections, Respiratory virus, Pneumovirus.

INTRODUCTION

An estimated 1.9 to 2.2 million people die from acute respiratory infections (ARI) each year, with 70% of those deaths occurring in underdeveloped nations, making up 30% of all paediatric fatalities.[1] The high rates of morbidity and mortality in humans, which have emerged as a global public health concern, are caused by ARTIs. There are numerous viruses, including the human respiratory syncytial virus (hRSV), influenza virus, and coronavirus, have been associated in the prevalence of ARTIs. In 2001, a research team in the Netherlands first discovered a novel virus associated with ARTIs, which was named human metapneumovirus (HMPV). A significant causative agent of upper and lower respiratory tract infections, particularly in children under five and the elderly, is human metapneumovirus (hMPV).[2]

HUMAN METAPNEUMOVIRUS

HMPV belongs to the order Mononegavirales, the Paramyxoviridae family; which is divided into the subfamilies Paramyxovirinae and Pneumovirinae. The Pneumovirinae subfamily is further divided into two genera, Pneumovirus and Metapneumovirus. hRSV is placed under the genus Pneumovirus, while hMPV is placed under the genus Metapneumovirus. HMPV was first detected in the respiratory secretions of 28 young children in the Netherlands and had initially stood out from

other common respiratory viruses. Van den Hoogen and her colleagues had attempted to identify the unknown virus using PCR-based techniques utilising virus genome-specific primers and immunological assays employing virus-specific antibodies, but these techniques could only screen for known respiratory viruses.

When researchers began applying molecular biology techniques, the genetic characteristics and portions of the genomic sequences of the virus could be identified. These techniques included the randomly primed PCR technique, which acquired the limited sequence information required to establish a direct connection between this novel virus and the avian pneumovirus (AMPV).[3] Due to its similar resemblance to AMPV, the new virus is known as human metapneumovirus, signifying that it is a metapneumovirus and that its host is human.

EPIDEMIOLOGY

HMPV has a seasonal distribution with isolation on every continent. In the northern hemisphere, outbreaks often take place from January to March, while in the southern hemisphere, they typically happen from June to July.[4] According to a recent study, after the RSV and influenza infection seasons, the peak of hMPV seasonal incidence occurs between March and April.[5] According to serologic research, almost all children globally have been exposed to the virus by the time they are five years old. Reinfections are prevalent in older children and adults, even though early infection is almost universal. HMPV may cause mild upper respiratory tract infection (e.g., the common cold). The risk of serious illness and hospitalization, however, is higher for older adults over 65, immunocompromised individuals, and premature babies.[6] In some studies of hospitalizations and emergency room visits, HMPV is nearly as common and severe as influenza in older adults. In adults with chronic obstructive pulmonary disease (COPD) and asthma, it is linked to cause more severe illness. Numerous outbreaks of HMPV have been reported in long-term care facilities for children and adults, causing fatalities.[7]

CLINICAL FEATURES

The clinical manifestations of an hMPV infection are indistinguishable from those of an RSV infection, especially in young children. Patients are generally diagnosed with bronchiolitis, bronchitis, and pneumonia. They show common symptoms like fever, cough, hypoxia, upper respiratory tract infection, lower respiratory tract infection, and wheezing.[5] In hMPV-positive individuals, fever typically lasts 10 days on average, with a peak during the course of the illness. Young adults with hMPV re-infection show mild cold and flu-like symptoms, with fever in a small proportion of infected cases. Re-infection, however, can cause serious symptoms (such pneumonitis) and even mortality in older people.

DETECTION

HMPV (Human Metapneumovirus) detection has traditionally relied on the use of reverse-transcriptase polymerase chain reaction (RT-PCR) to amplify RNA extracted from respiratory samples. However, more cost-effective methods for nucleic acid-based detection of HMPV have been explored. These alternative techniques include Immunofluorescent-antibody testing to detect HMPV antigens in nasopharyngeal secretions. Immunofluorescence staining with monoclonal antibodies is used to identify HMPV in nasopharyngeal samples and shell vial cultures. Immunofluorescence assays are used for detecting HMPV-specific antibodies in cultured cells with the use of polyclonal antibodies and direct virus isolation. These techniques provide a range of choices for HMPV detection, each with unique benefits in terms of affordability and ease of use, all while accurately identifying the virus.[4]

TRANSMISSION

Contact with infected secretions, whether through droplet, aerosol, or fomite vectors, is most likely the mode of transmission.

Hospital-acquired infections with human metapneumovirus have been reported. HMPV has been shown to circulate during fall and winter months with alternating predominance of a single subtype each year.[8]

TREATMENT

As of 2008, there is no known therapy for humans. In an animal model, ribavirin, a drug used to treat RSV, has shown efficacy.[9] In a recent study, a live attenuated vaccine strain of hMPV was developed by changing the glycosylation site of the F protein. This vaccine was found to provide complete protection against homologous virus challenge and some protection against heterologous viral challenge, even at 56 days post-inoculation.[10] All of these results leading more thorough understanding of the molecular pathophysiology of hMPV is necessary before an effective vaccine against it can be created.

RECENT OUTBREAK

6.2 percent of positive respiratory illness tests in China were connected to the HMPV virus alone, whereas COVID-19, rhinovirus, or adenovirus account for 5.4 percent of respiratory illness hospitalisations. The Chinese Center for Disease Control and Prevention published data showing that respiratory infections had risen significantly in the week of 16 to 22 December 2024.[11]

CONCLUSION

Human metapneumovirus is a relatively recently described virus, and hMPV appears to be as dangerous a pathogen as hRSV in terms of morbidity and mortality.[5] Understanding the pathophysiology of hMPV and the molecular limitations causing severe disease is crucial for both treating infections and creating an effective vaccine against this significant respiratory virus. Recent studies using animal models for hMPV infection and reverse genetics platforms have shed some light on hMPV pathogenesis and have allowed us to evaluate live vaccine candidates. Now we need to initiate the clinical trials to evaluate the different modalities of treatment available for hMPV infection.

Declaration by Authors

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