A REVIEW ON RECENT TRENDS OF HUMAN METAPNEUMOVIRUS (HMPV)

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ABSTRACT

Respiratory tract infections in children, adults, the elderly, and individuals with impaired immune systems are frequently caused by the human metapneumovirus (HMPV). It was moved to the Pneumoviridae family in 2016 from the Paramyxovirdae family. Genetic groups A and B, which are further subdivided into subclasses consisting of A1, A2, B1, and B2, with year-to-year variability, make up this virus. Although HMPV was first identified in the Netherlands in 2001, it has now spread around the world. Respiratory droplets from infected individuals are the main way that HIV is transmitted. Children's respiratory issues can be caused by a variety of etiological causes. Determining the etiological agents of these illnesses is crucial because of this. Visits to the ER or a primary care physician's office may result from an HMPV infection. The symptoms of an HMPV infection in adult patients can range from moderate upper respiratory tract infections to severe pneumonia, or they might be asymptomatic[10]. The majority of patients arrive with dyspnea, nasal congestion, and coughing. There have also been reports of purulent cough, wheezing, sore throat, fever, pneumonia, bronchiolitis, conjunctivitis, and otitis media[11]. Adults infected with HMPV were less likely than those infected with RSV or influenza to report having a fever. In this article, we will cover the current knowledge on the prevalence, clinical manifestation, diagnosis, prognosis, management, prevention and patient safety on hMPV, which has changed significantly in recent years. With a focus on potential methods for hMPV prevention, we will also examine the treatment techniques and tactics now employed to manage hMPV infection.

KEYWORDS: Human metapneumovirus, bronchiolitis, nucleic acid amplification assays, parainfluenza viruses, hMPV

INTRODUCTION

Respiratory tract infections in children, adults, the elderly, and individuals with impaired immune systems are frequently caused by the human metapneumovirus (HMPV). It was moved to the Pneumoviridae family in 2016 from the Paramyxovirdae family. Genetic groups A and B, which are further subdivided into subclasses consisting of A1, A2, B1, and B2, with year-to-year variability, make up this virus. Although HMPV was first identified in the Netherlands in 2001, it has now spread around the world. Respiratory droplets from infected individuals are the main way that HIV is transmitted[1]. Children's respiratory issues can be caused by a variety of etiological causes. Upper respiratory tract infections have substantial social costs in the form of missed work, missed school days, and increased medical expenses, despite the fact that they are often less dangerous. Determining the etiological agents of these illnesses is crucial because of this. We have established the significance of recognized viral infections such as the coronavirus, rhinovirus, influenza virus, parainfluenza virus, and human respiratory syncytial virus (hRSV) via decades of study and epidemiological investigations. A significant percentage of respiratory tract infections, nonetheless, are still unattributable to any recognized pathogen in spite of these investigations[2]. HMPV infection typically happens by the age of five, while reinfection can happen at any time. Upper and/or lower respiratory tract infections are the most prevalent clinical situation brought on by HMPV infection, with lower respiratory tract infections being one of the most frequent. Acute asthma flare-ups, bronchiolitis, and pneumonia can result from HMPV-caused lower respiratory tract infections. Supportive care measures, including extra oxygen, antipyretic medications, and intravenous fluids for hydration if necessary, are the cornerstone of therapy[3].

SEROPREVALENCE OF HMPV

Seroconversion can be used to identify primary HMPV infection in children, which usually happens in the first one to two years of life. Eighty percent of two-month-old children in an Israeli cohort exhibited HMPV antibody evidence, which is indicative of maternal immunity transfer and the wide adult seroprevalence. At 13 months, just 30% of children were seropositive, which is consistent with declining maternally produced antibodies. At 24 months, however, 52% of children exhibited HMPV antibodies, indicating a primary infection[4].

VIROLOGY

HMPV's genomic orientation is similar to that of other Paramyxoviridae family members. The avian pneumovirus, especially type C, and hMPV share a very similar genomic structure. With the exception of a few variations in gene order and the lack of the non-structural genes from the hMPV genome, the genomes of hMPV and hRSV are quite similar. It has been determined that the two non-structural proteins of hRSV are strong multifunctional antagonists of the interferon signaling pathways. The difference in the degree of host innate immune response seen during hRSV and hMPV infections may be due to the lack of these proteins[5]. The lipid envelope envelops the RNA core, which is encircled by the M protein. The F, SH, and G surface glycoproteins are present in this envelope as spikes that range in size from 13 to 17 nm. The P, N, L, M2-1, and M2-2 proteins are linked to the core nucleic acids, which combine to create a nucleocapsid with a diameter of 17 nm. Heparan sulphate receptors on the

cell surface are where hMPV binds and fuses with the aid of the G and F proteins. Following the fusion process, the viral nucleocapsid replicates by entering the host cell's cytoplasm. The freshly created viral genome approaches the host cell membrane after joining the viral P, N, L, and M2 proteins[6]. The creation of the viral ribonucleoprotein (RNP) complex during virus replication is made possible by the P protein stabilizing the L protein. The M protein interacts with the RNP complex to perform a critical role in viral assembly and budding. Through the regulation of pattern recognition receptors, including retinoic acid-inducible gene-like receptors, toll-like receptors, and other signaling molecules, the virus counteracts cellular reactions. Infection decreases the activation of antigen-specific T cells and disrupts dendritic cell function. The likelihood of re-infection rises as a result of the virus's inadequate clearance[7, 8].

PATHOPHYSIOLOGY

Respiratory droplets are the means by which human metapneumovirus is transmitted from person to person. HMPV incubation lasts anywhere from three to five days, depending on the person. Following inoculation inside the mucosa of the nasopharynx, the virus can quickly move into the respiratory system. About eight genes that code for nine distinct proteins that cause host cell infection are present in HMPV. By attaching itself to integrins on the surface of the host cell to enable access into the host cell, the fusion glycoprotein (F) facilitates transmembrane fusion with the aid of the attachment glycoprotein (G). After entering the cytoplasm of the host cell, the viral nucleocapsid replicates[9].

CLINICAL MANIFESTATION

The symptoms of an HMPV infection in adult patients can range from moderate upper respiratory tract infections to severe pneumonia, or they might be asymptomatic[10]. The majority of patients arrive with dyspnea, nasal congestion, and coughing. There have also been reports of purulent cough, wheezing, sore throat, fever, pneumonia, bronchiolitis, conjunctivitis, and otitis media[11]. Adults infected with HMPV were less likely than those infected with RSV or influenza to report having a fever[12]. Children with HMPV infections reported more hoarseness. Infections can be severe in immunocompromised persons, the elderly, and those with pulmonary or cardiovascular conditions[13, 14]. Laboratory testing may reveal increased transaminases, neutropenia, and lymphopenia. Research on imaging using computed tomography (CT) and chest X-rays reveals that symptoms of acute interstitial pneumonia first appear before developing into bronchiolitis[15].

TRANSMISSION

It is believed that direct or close contact with infected secretions—which might include saliva, droplets, or big particle aerosols—is how HMPV is spread. Excretions containing HMPV RNA are detected five to two weeks after the onset of symptoms[16]. According to two isolated occurrences of nosocomial HMPV infections, the virus takes four to six days to incubate. The predicted incubation time for a nosocomial HMPV infection in a pediatric hemato-oncology hospital was 7–9 days. A retrospective investigation examined the transmission of HMPV in Japanese homes. All 15 of the families under study had children

enrolled in nursery homes, daycare centers, or elementary schools who were index-patients. The symptoms of contact cases appeared on average five days after those of the index case[17].

Since only symptomatic patients were included in this retrospective investigation, it was impossible to pinpoint the precise number of transmissions in homes. Asymptomatic adults may be an overlooked source of HMPV transmission, since two investigations discovered that 4.1% of them had the virus. Nevertheless, additional research revealed that it is rare for asymptomatic individuals' excretions to have HMPV RNA[18].

DIAGNOSIS

Numerous methods can be used to diagnose HMPV infection, including as culture, serologic testing, nucleic acid amplification assays (NAAT), and antigen detection. Because HMPV develops slowly in traditional cell culture and has minor cytotoxic effects, virus culture is comparatively challenging. The term shell vial amplification refers to the quick culture method[19].

Only epidemiologic studies use serologic testing to detect the immune response against the virus. One drawback of serology is the relatively long time lag between virus transmission and the detection of HMPV-specific IgM and IgG antibodies; however, a combination of serology and RT-PCR has improved diagnostic value in the diagnosis of HMPV infections when determining the extent of an outbreak, such as in long-term care facilities[20].

PROGNOSIS, MANAGEMENT AND COMPLICATION

Supportive interventions are the pillars of therapy. Patients who have a fever are prescribed antipyretic drugs such acetaminophen and ibuprofen. Intravenous fluid hydration is recommended if the patient seems dehydrated and is unable to handle oral hydration. Furthermore, individuals with HMPV may need additional oxygen support, such as a high flow nasal cannula or, in extreme situations that result in acute respiratory failure, mechanical ventilation. This is particularly true for patients who already have a respiratory or cardiac condition or who are immunocompromised. The majority of people do fully recover. Droplet measures should be implemented for all HMPV patients in order to restrict and stop the spread of the virus. As of right now, there is no vaccination against HMPV. Although several vaccines against distinct HMPV structures have been tested on non-human primates and rodents and show promise, none have been tested on human volunteers[21, 22]. Noninfectious reasons including acute asthma and acute, chronic exacerbations of obstructive lung disease are included in the differential diagnosis for symptoms that resemble HMPV infection. The clinical presentation of pneumonia caused by bacterial infections might be comparable. Coronaviruses, rhinoviruses, adenoviruses, parainfluenza viruses, respiratory syncytial viruses, and influenza A and B are among the other viruses that need to be taken into account[23]. The prognosis for human metapneumovirus is favorable. In order to assess the severity of an infection, the doctor must be aware of the patient's underlying medical problems as well as symptoms including hypoxia, dyspnea, and the usage of auxiliary muscles. In most cases, patients recover completely with supportive care measures. Reinfection may happen, indicating temporary and insufficient protection against HMPV[21]. HMPV can result in serious sickness that necessitates hospitalization in some patient groups. Patients with a pre-existing heart or respiratory ailment

or those with impaired immune systems are among them. Acute respiratory failure needing high flow oxygen support is more likely to occur in these individuals, and some may even worsen to the point where mechanical ventilation is necessary. Patients in these situations must be admitted to the critical care unit for careful observation[24].

PATIENT SAFETY AND EDUCATION

Visits to the ER or a primary care physician's office may result from an HMPV infection. In order to prevent, identify, and cure diseases, an interdisciplinary team approach is crucial. The physician and nurse must teach parents and patients how to properly wash their hands and the value of using disinfectants at home if the patient is stable enough to receive treatment as an outpatient. When additional family members are present, this is especially important for people who are prone to illnesses. In order to prevent transmission, the nurse should make sure the patient is in a different area of the hospital and is under respiratory droplet precautions. This is especially important if the patient is being hospitalized. Anyone providing direct patient care, including the patient's parents, the doctor, the nurse, and others, should cover their mouth and nose with a mask. Additionally, before entering and leaving the room, they had to wash and sterilize their hands. In order to assess the severity, course, and high-risk individuals of the condition, the physician should also confirm the patient's medical history. The nurse should notify the physician of any changes in the patient's vital signs and respiratory condition while the workup is underway. This aids in determining whether the patient need immediate care, such as mechanical breathing or more oxygen. If necessary, the pharmacist can assist in informing patients and parents that there are no pharmaceutical therapies for HMPV and that the primary focus of therapy is supportive. These actions improve results and ensure the safety of patients with HMPV and others by strengthening patient-centered care[25].

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation.

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