Mucosal immunity against COVID-19

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Introduction

The immune system is a complex component of the human body, essential for fighting the invading pathogens and protecting the body against infectious diseases. Mucosal immunity is a compartment of the adaptive type of immunity that is highly vulnerable to infections due to the permeability of the mucosa, making it the most susceptible and the first gateway for the entry of pathogens [1]. The mucosal associated lymphoid tissues (MALT) are responsible for initiating the immune responses to specific antigens on the mucosal surfaces in the body in the inductive sites, by the production of secretory IgA in the effector sites [2]. The Secretory IgA is an abundant antibody in the mucosal immunity, that neutralizes the respiratory viruses or prevents the virus attachment to the epithelial surfaces, thus preventing its dissemination in the system [3]. Since Corona virus disease (COVID-19), a recent infectious respiratory pandemic, firstly infects the mucosal immunity, further consideration should be attributed to the effectiveness of MALT in preventing the progression of the virus into the severe form, by controlling the virus in its initial stage, as well as acknowledging the importance of the mucosal immunity in human milk of infected mothers, asymptomatic patients, children & the development of a nasal vaccine [4].

Secretory IgA in human milk

Although concerns are raised regarding the transmission of the COVID-19 to the newborns via the infected mothers, a recent report found a strong sIgA antibody (component of mucosal antibody) SARS-CoV-2 immune response in the breastmilk from 80% of the previously infected with Covid-19[5]. One of the potential protective mechanisms might be due to the passive immunity passed to the newborn via the previously infected mother. Therefore, the milk of the infected mothers can serve as a therapeutic and protective method to establish the passive immunity of the newborns, as the sIgA antibody produced could be much effective than the immunoglobulins or plasma [5]. Hence, the convalescent milk Ab can be utilized to treat COVID-19, as well as protect the infants against COVID-19 infection [5].

The role of mucosal immunity in mild/ asymptomatic patients

As stated by the WHO report, research revealed that COVID-19 symptoms are primarily mild or asymptomatic in 80% of the cases [6]. A suggested explanation to the mechanism behind the severity of COVID-19 symptoms can be attributed to the early production of secretory IgA by the mucosal immunity, as supported by a recent study that detected the sIgA in 92.7% of the subjects, having the highest prevalence, in comparison to the other antibodies [7]. This suggests the prospective behavior of corona virus being similar to the other respiratory viruses, that initiates the amplified production of sIgA , as a protective mechanism to maintain the asymptomatic or mild symptoms, and prevents the progression of the virus into the severe deadly form, led by the IgG [8]. Consequently, the sIgA functions as a neutralizing agent to the corona virus, in the nasal passages and the oral cavity containing the virus, before it reaches the terminal airways and leads to severe respiratory distress [4]. Accordingly, this results in a tolerable symptoms and faster recovery.

Resistance of COVID-19 in children [9]

Age is a major risk factor that is highly correlated with the severity of symptoms in COVID-19, as elderly are expected to have exaggerated symptoms, in compared to the young individuals that experience mild or no symptoms. This is due to the different immune response to the disease, the nature of the human body, and the underlying health conditions that are correlated with increased age (ex: diabetes, cardiac & hypertension) [9].

Children on the contrary account for only 1–2% of the COVID-19 cases, illustrating a form of resistance to the disease [10]. There are several hypotheses proposed to the cause of resistance in children, one is the presence of Bronchus Associated Lymph Tissues (BALT) a constituent of the mucosal immunity present in the children airways, that is initiated by infections [4]. Moreover, another mechanism is by production of sIgA, which dominates in COVID-19 infections, by therefore controlling the virus at the site of infection [11]. Lastly, a recent report verified the decreased ACE-2 (a receptor for SARS-COV) gene expression in the nasal epithelium of children in comparison to adults; this clarifies the diminished function of ACE-2 resulting in an enhanced protection against COVID-19[12].

A potential nasal vaccine

COVID-19 is acquired through inhalation of the virus or its contact with the nose or the eye [13]. Research discovered the expression of the viral RNA only in the upper respiratory tract in early COVID infection, as well as ACE-2 protein localization in the apical area of the upper nasal respiratory epithelium; that is hypothesized to cause nasal symptoms [14]. Anosmia is the most common nasal symptom experienced by 89.23% of COVID patients, mainly caused by the upper respiratory infections [15]. Although the exact cause on anosmia remains unclear, a recent research suggested that anosmia is likely to be caused by non-neuronal expression of ACE-2 (SARS-COV-2 entry gene), leading to smell dysfunction in COVID patients [16].

Therefore, suggested nasal antivirals can be considered as a therapeutic agent to direct the virus concentrated in the nasal epithelium, thus reducing such symptoms related to the olfactory dysfunction.

The initial immune response is introduced by the nasopharynx associated lymph tissue (NALT), through the generation of Th-1 &Th-2 lymphocytes and IgA committed B cells [16]. Consequently, when the pathogen is recognized, the CD8+ T memory cells initiate a defense mechanism which prevents the virus from progressing to the lower respiratory tract [17]. This can give rise to a potential nasal vaccine with an adjuvant that induces sIgA and provides lifelong immunity, given the advantages it provides such as it being needleless, can be given to adults and children with minimal side effects [18].

Conclusion

In conclusion, mucosal immunity should be acknowledged for its significant efficiency in combating COVID-19, as it is the gateway of entry of pathogens and has a significant role in controlling the virus and preventing its progression. Moreover, given its protective mechanism in human milk, this can be utilized as a therapeutic agent. Lastly, the powerful characteristics of the mucosal immunity leads to an important invention; the nasal vaccine, providing a long-lasting immunity for all age groups safely, conveniently and non-invasively.

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