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Editorial

How the Gut Microbiome Is Altered in COVID-19

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Microbioma and Viral Infections Respiratory infections are some of the main causes of hospitalization and mortality in older patients, especially [1]. In this context, intestinal and respiratory microorganisms, as well as the changes with which they are associated with, as well as the concepts of inflammation and immunosenescence [2], cause older people to be sensitive to infection. Recent studies have shown that viral infections, such as influenza and respiratory viruses, cause imbalances in the intestinal microbiome, even in the absence of local viruses. Intestinal dysbiosis is one of the main factors influencing the adaptive response to respiratory pathogens, which is beneficial after virus pneumonia [3]. Viral infections also affect respiratory microorganisms and cause an increase in upper respiratory tract pathogens, such as Staphylococcus aureus and Streptococcus pneumonia [4]. This phenomenon increases the risk of bacterial pneumonia associated with viral infection. Viral infections are also enhanced by the metabolites of microorganisms related to the pathogen, such as interactions between flu viruses and Streptococcus pneumoniae, which inhibit biofilms and stimulate bacteriocosa. Knowledge of these mechanisms could allow for the prevention of bacterial superinfections during viral outbreaks.

Anti-Influental Vaccination and Microbioma Infected elderly people have a higher risk of complications and mortality. Therefore, vaccination is promoted, and the effectiveness of vaccination may be less pronounced for older people. In fact, at least in part, the decreased protective effectiveness of vaccines may be due to microbe disease during aging and changes in adaptive response [5,6]. A recent meta-analysis showed that the use of probiotics improved the immune response to influenza vaccines, but further research needed to clarify the biological mechanism of the phenomenon. Recent studies on co-owners of patients with viral flu have shown that there is a significant correlation between respiratory microorganisms, especially some oligotypes, and increased risk of flu infection [7,8]. These data indicate that microorganisms play an important role in the clinical course of flu, but further studies are needed to clarify the pathological and physiological mechanisms of these observations.

COVID-19 and Fragility The recent epidemic of COVID-19 has demonstrated and tragically proved the definition of fragility: a condition of increased vulnerability in individuals, characterized by changes in multisystemic physiopathology, reduced ability to respond to stressful situations, and increased risk of negative events, such as hospitalization and death [9]. Fragility is a multidimensional condition, and clinical, biological, functional, and psychosocial factors determine the onset and progress of disease [10]. In this respect, modern methods of diagnosis and treatment of elderly people with disabilities provide a multidimensional clinical approach [11]. The difficult management of COVID-19 in elderly persons, with serious morbidity and significantly higher mortality rates, was identified several factors: the lack of specific treatment, the existence of multimorbidities and functional and cognitive disabilities, family or other caregivers' assistance, and the risk of a number of side effects associated with the isolation system, which are largely hampered by the lack of specific therapies. This last factor, above all, complicates the use of experimental treatments (see hydroxychloroquine and immunosuppressants), increases interest in a more "ecological" approach, and reduces side effects, including effects on intestinal bacteria.

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Microbioma and COVID-19 Some recent studies have shown a significant association between SARS-CoV-2 infection and intestinal microbiological dysbiosis, as confirmed by severe diarrhea (usually 2–36%), as well as the presence of SARS-CoV-2 viruses in fecal specimens of COVID-19 patients [12]. Furthermore, intestinal microbiome changes are associated with increased opportunistic pathogen germs and the deterioration of protective bacteriophages associated with the fecal levels of SARS-CoV-2 and the severity of COVID-19 symptoms, which remain characteristic even after SARS-CoV-2 is eliminated and disease symptoms are corrected [13]. It is particularly interesting to note that the severity of clinical symptoms is associated with older age and disease, which are related to inflammation and changes in the qualitative and quantitative composition of intestinal microorganisms. As a result, it is hypothesized that interventions aimed at strengthening intestinal barriers and reducing inflammation, which is done adopting a diet rich in fibers and fermented foods, can be useful to contain COVID-19's gastrointestinal symptoms. In a Chinese study, a significant reduction in the number of lactic acid bacteria and bicobacteria in patients with COVID-19 was observed in a significant reduction in intestinal bacterial bacteria; however, the clinical significance of this observation has not yet been defined. However, there is no doubt that changes in intestinal microorganisms may lead healthy people to abnormal inflammation and explain the sensitivity and severity of COVID-19 further [14,15]. Scientific evidence indicates that "cytokine storms" may be an important mechanism for the severity and death of COVID-19 patients [16,17]. Therefore, antigen therapy to suppress patients' hypersensitivity is a recommended strategy for the treatment of severe COVID-19 [18,19]. Increased evidence suggests that microbes play a fundamental role in triggering, training, and functioning with regard to the host immune system, and it also indicates that intestinal microbes and their activity are involved in inflammatory cell production [20,21]. Previous studies have shown that Lactobacillus is positively associated with IL-6 and IFN-, while Blautia is positively associated with it [22–24]. In terms of data on the use of probiotics in COVID-19, there are still too few available results to draw clinical indications. In fact, the reason for using probiotics for COVID-19 is based on indirect evidence. The use of conventional "blind" probiotics does not seem to be recommended until the pathogenesis and effects of SARS-CoV-2 infection on intestinal microbes are fully understood. However, the intervention strategy that aims to modulate intestinal microbes may be one of the treatments for COVID-19 and its complications [25,26].

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