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Overview of COVID-19 : Current scenario and role of Ayurvedic measures

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ABSTRACT

Viral diseases are one of the major causes of devastation in human history world wide. Bacterial and parasitic diseases can be controlled by the use of effective antibodies and anti-parasitic agents respectively. Since viruses do replicate inside the cells and any intervention will affect the cellular metabolism of the host. Development of antiviral drug is a challenge. COVID-19 is the infectious disease caused by the most recently discovered corona virus. This new virus and disease were unknown before the outbreak began in Wuhan, China, in December 2019. COVID -19 is declared as a pandemic by WHO in the month of March. No cure has yet been found for the disease; however, nowadays it is being managed through symptomatic treatment by using corticosteroids and antibiotics to prevent or subside bacterial infections. As all infected people do not develop severe disease and even most of them are having either mild symptoms or symptoms less. From the recent data we found that most of the patients who developed severe symptoms have already had some chronic ailments like diabetes, HTN and were already in an immune-compromised state. So, through Ayurvedic approach we can try to boost up immunity of the patient and hence can reduce the mortality rate and burden of providing health facilities in our country.

Key words: *Covid-19, Ayurveda, Immunity, Immuno compromised state.*

INTRODUCTION

Corona virus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2).[1] It was first identified in December 2019 in Wuhan, Hubei, China, and has resulted in an ongoing pandemic.[2,3] As of 13 August 2020, more than 20.6 million cases have been reported across 188 countries and territories, resulting in more than 749,000 deaths. More than 12.8 million people have recovered.[4,5] There are approximately 17 million cases and more than 6 lakhs deaths have been reported globally till August 1, 2020 by WHO. In India, the figure has risen to about 16 lakhs of total cases and 36,511 cases have deceased during fighting with the disease. In India, the prevalence rate is more in places with crowded areas like Delhi and certain cities of Maharashtra, Tamilnadu.[6]

Corona viruses are a family of viruses that can cause illnesses such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new corona virus was identified as the cause of a disease outbreak that originated in China. The virus is now known as the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2). The disease it causes is called corona virus disease 2019 (COVID-19). Signs and symptoms of corona virus disease 2019 (COVID-19) may appear two to 14 days after exposure. This time after exposure

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and before having symptoms is called the incubation period. Common signs and symptoms can include fever, cough and tiredness. Early symptoms of COVID-19 may include a loss of taste or smell. Other symptoms can include shortness of breath or difficulty in breathing, muscle aches, chill, sore throat, runny nose, headache, chest pain.[7]

Pathophysiology

Corona viruses are enveloped, positive-sense, single-stranded RNA viruses of ~30 kb. They infect a wide variety of hostspecies.[8] They are largely divided into four genera; α, β, γ, and δ based on their genomic structure. α and β coronaviruses infect only mammals. In contrast, SARS-CoV, Middle East respiratory syndrome corona virus (MERS-CoV) and SARS-CoV-2 are classified to β corona viruses.[9]

The life cycle of the virus with the host consists of the following 5 steps: attachment, penetration, biosynthesis, maturation and release. Once viruses bind to host receptors (attachment), they enter host cells through endocytosis or membrane fusion (penetration). Once viral contents are released inside the host cells, viral RNA enters the nucleus for replication. Viral mRNA is used to make viral proteins (biosynthesis). Then, new viral particles are made (maturation) and released. Corona viruses consist of four structural proteins; Spike (S), membrane (M), envelop (E) and nucleocapsid (N).[10] Spike is composed of a transmembrane trimetric glycoprotein protruding from the viral surface, which determines the diversity of corona viruses and host tropism. Spike comprises two functional subunits; S1 subunit is responsible for binding to the host cell receptor and S2 subunit is for the fusion of the viral and cellular membranes. Angiotensin converting enzyme 2 (ACE2) was identified as a functional receptor for SARS-CoV.[11] ACE2 expression was high in lung, heart, ileum, kidney and bladder.[12] In the lung, ACE2 was highly expressed on lung epithelial cells. Whether or not SARS-CoV-2 binds to an additional target needs further investigation. Following the binding of SARS-CoV-2 to the host protein, the spike protein undergoes protease cleavage. After the cleavage at the S1/S2 cleavage site, S1 and S2 subunits remain non-covalently bound and the distal S1 subunit contributes to the stabilization of the membrane-anchored S2 subunit at the prefusion site. Subsequent cleavage at the S'2 site presumably activates the spike for membrane fusion via irreversible, conformational changes. The corona virus spike is unusual among viruses because a range of different proteases can cleave and activate it. The characteristic unique to SARS-CoV-2 among corona viruses is the existence of furin cleavage site ("RPPA" sequence) at the S1/S2 site. The S1/S2 site of SARS-CoV-2 was entirely subjected to cleavage during biosynthesis in a drastic contrast to SARS-CoV spike, which was incorporated into assembly without cleavage. Although the S1/S2 site was also subjected to cleavage by other proteases such as transmembrane protease serine 2 (TMPRSS2) and cathepsinl, the ubiquitous expression of furin likely makes this virus very pathogenic.[13,14,15]

Host response to SARS-CoV-2

The symptom of patients infected with SARS-CoV-2 ranges from minimal symptoms to severe respiratory failure with multiple organ failure. On Computerized tomography (CT) scan, the characteristic pulmonary ground glass opacification can be seen even in asymptomatic patients.[16] Because ACE2 is highly expressed on the apical side of lung epithelial cells in the alveolar space, this virus can likely enter and destroy them.[17,18] This matches with the fact that the early lung injury was often seen in the distal airway. Epithelial cells, alveolar macrophages and dendritic cells (DCs) are three main components for innate immunity in the airway.[19] DCs reside underneath the epithelium. Macrophages are located at the apical side of the epithelium. DCs and macrophages serve as innate immune cells to fight against viruses till adaptive immunity is involved. T cell mediated responses against corona viruses have been previously reviewed.[20] T cell responses are initiated by antigen presentation via DCs and macrophages. How does SARS-CoV-2 enter APCs? DCs and macrophages can phagocytize apoptotic cells infected by virus.[21] For example, virus-infected apoptotic epithelial cells can be phagocytized by DCs and

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macrophages, which lead to antigen presentation to T cells. Or DCs and macrophages may be infected with viruses primarily? Based on the Immunological Genome database (http://rstats.immgen.org), the expression of ACE2 on (splenic) dendritic cells and alveolar macrophages is present but limited. Determining whether or not SARS-CoV-2 uses another protein to bind to APCs helps to answer this question. SARS-CoV can also bind to dendritic-cell specific intercellular adhesion molecule-3-grabbing non integrin (DC-SIGN) and DC-SIGN-related protein (DC-SIGNR, L-SIGN) in addition to ACE2.[22,23,24] DC-SIGN is highly expressed on dendritic cells and macrophages. Another target for SARS-CoV-2, if any, can help the virus to directly infect DCs and alveolar macrophages. This needs future research. These antigen presenting cells move to the draining lymph nodes to present viral antigens to T cells. CD4+ and CD8+ T cells play a critical role. CD4+ T cells activate B cells to promote the production of virus-specific antibody, while CD8+ T cells can kill viral infected cells.[25]

Clinical Presentation

Clinical and epidemiological data from the Chinese CDC and regarding 72,314 case records (confirmed, suspected, diagnosed, and asymptomatic cases) were shared in the Journal of the American Medical Association (JAMA), providing the first important illustration of the epidemiologic curve of the Chinese outbreak. There were 62% confirmed cases, including 1% of cases that were asymptomatic, but were laboratory positive (viral nucleic acid test). Further more, the overall case-fatality rate (in confirmed cases) was 2.3%. Of note, the fatal cases were primarily elderly patients, in particular those aged ≥ 80 years (about 15%) and 70 to 79 years (8.0%). Approximately half (49.0%) of the critical patients and affected by preexisting comorbidities such as cardiovascular disease, diabetes, chronic respiratory disease and oncological diseases, died. While 1% of patients were aged 9 years or younger, no fatal cases occurred in this group. The authors of the Chinese CDC report divided the clinical manifestations of the disease by their severity.

- **Mild disease:** Non-pneumonia and mild pneumonia; this occurred in 81% of cases.
- **Severe disease:** Dyspnea, respiratory frequency ≥ 30/min, blood oxygen saturation (SpO2) ≤ 93%, PaO2/FiO2 ratio or P/F [the ratio between the blood pressure of the oxygen (partial pressure of oxygen, PaO2) and the percentage of oxygen supplied (fraction of inspired oxygen, FiO2)] < 300, and/or lung infiltrates > 50% within 24 to 48 hours; this occurred in 14% of cases.
- **Critical disease:** respiratory failure, septic shock, and/or multiple organ dysfunction (MOD) or failure (MOF); this occurred in 5% of cases.[26]

Diagnostic criteria

According to the seventh edition of MMR (3 March 2020), to confirm the suspected case needs to combine any one item of epidemiological history features with two items of clinical manifestations to make a comprehensive analysis, or needs to meet three items of clinical manifestations if without clear epidemiological history:

Epidemiological history

1. A history of travel or residence in communities where COVID-19 cases had been reported in the last 14 days before symptom onset;
2. A history of contact with SARS-CoV-2 infectious cases (with positive nucleic acid test);
3. A history of contacting a cluster of confirmed cases (≥ 2 cases with fever and/or respiratory symptoms occurred within 2 weeks in small areas, such as home, office, class of school, etc).

Clinical manifestations

1. Fever and/ or respiratory symptoms;
2. Imaging features of COVID-19infection;
3. Total white blood cell counts showing normal or reduced lymphocyte count in the early onset stage.

However, anyone can catch COVID-19 and become seriously ill. People of all ages who experience fever and/or cough associated with difficulty in

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breathing/shortness of breath, chest pain/pressure, or loss of speech or movement should seek medical attention immediately. If possible, it is recommended to call the health care provider or facility first, so the patient can be directed to the right clinic.

Diagnosis

Diagnosing the confirmed case should base on suspected case with any one item of pathogenic or serological evidence as following: (1) SARS-CoV-2 nucleic acid positive in samples of sputum, pharynx swabs, and secretions of lower respiratory tract tested by real-time reverse-transcriptase–polymerase-chain reaction (rRT-PCR) assay.; (2) viral whole genome sequencing showing high homogeneity to the known novel coronaviruses; (3) positive for the specific IgM antibody and IgG antibody to SARS-CoV-2 in serum test; or a change of the SARS-CoV-2-specific IgG antibody from negative to positive.[27]

The ACR believes that the following factors should be considered regarding the use of imaging for suspected or known COVID-19 infection:

The Centers for Disease Control (CDC) does not currently recommend CXR or CT to diagnose COVID-19. Viral testing remains the only specific method of diagnosis. Confirmation with the viral test is required, even if radiologic findings are suggestive of COVID-19 on CXR or CT. For the initial diagnostic testing for suspected COVID-19 infection, the CDC recommends collecting and testing specimens from the upper respiratory tract (nasopharyngeal AND oropharyngeal swabs) or from the lower respiratory tract when available for viral testing.

Generally, the findings on chest imaging in COVID-19 are not specific, and overlap with other infections, including influenza, H1N1, SARS and MERS. Being in the midst of the current flu season with a much higher prevalence of influenza in the U.S. than COVID-19, further limits the specificity of CT.[28]

Preventions

Recommended measures to prevent infection include frequent hand washing, maintaining physical distance from others (especially from those with symptoms), quarantine (especially for those with symptoms), covering coughs, and keeping unwashed hands away from the face.[28] There are neither proven vaccines nor specific antiviral treatments for COVID-19. Management involves the treatment of symptoms, supportive care, isolation, and experimental measures.[29]

Ayurvedic Approach

In Ayurveda there is the term *Vyadhikshmatva* coined by *Acharya Charaka* in *Sutrasthana* 28th chapter which means the power of the body which decreases the *Bala* (or strength) of diseases and stops its progression. In modern terms it can be compared to immunity. *Acharaya Charaka* also mentioned that if a group of people aretaking the same uncompatible diet then it is not necessary that all of them get ill or if all people get ill then not all will die due to severity of disease. Some will recover.[30] This form the basis that there is a concept of immunity exists in Ayurveda and the herbs which boost up our immune system are called as *Rasayana* according to Ayurveda. There are three types of *Bala; Sahaj, Kalaj, Yuktikrita*.

Sahajbala can be compared with the immunity with which the child is born. *Kalajbala* is depend upon the age of a person and the seasonal variation as old people get ill easily as compared to adult one and also a person have low immunity in summer season as compared to winter according to Ayurveda Whereas *Yuktikrtabala* is achieved when a person take wholesome diet that means a person taking balanced diet has good immunity as compared to the one who takes improper diet.[31] In many *Samhita* there are some drugs given by *Acharyas* to enhance *Bala* i.e, immunity. Some experimental research has been done on the herbs which have been used to boost up immunity *(Bala)* since ancient times mentioned in Ayurveda to check their potential. In order to investigate mechanism of action of the *Rasayana* e.g. *Tinospora cordifolia* studies are carried out on the proliferative fraction of the bone marrow of mice by flow cytometry and found that compared with normal mice, there was a significant increase in the proliferative fraction in the bone marrow in mice treated with the *Tinospora cordifolia.*

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The active principles of *Guduchi* (*Tinospora cordifolia*), have been found to possess anticomplementary and immunostimulating activities. Previous studies on the extracts of *Guduchi* reported anti-inflammatory and hepatoprotective activities. Syringin (TC-4) inhibited the in vitro immune haemolysis of antibody coated erythrocytes. The reduced immunohaemolysis was found to be due to inhibition of the C3-convertase of the classical complement pathway. Humoral and cell mediated immunity were also dose dependently enhanced. Macrophage activation was reported for cordioside (TC-2), cardiofolioside – A (TC-5) and Cordiol (TC-7). These compounds induced significant increase in phagocytic activity by activation of the peritoneal macrophages (Kapil A. and Sharma S., 1997). It is important to recall here that macrophages play an important role in nonspecific and specific immune responses. In innate immunity, the phagocytosis of foreign bodies by macrophages and other phagocytes contributes to regulation of both humoral and cellular immune responses.[32]

Macrophages are the second line of defense and constitute important participants in the bi-directional interaction between innate and specific immunity. Macrophages are in a quiescent form and are activated when given a stimulus. Enhanced secretion of lysozyme by macrophage cell line J774A on treatment with *Tinospora cordifolia* and lipopolysaccharide was observed, suggesting activated state of macrophages. Enhanced lysozyme production was reported at different time intervals (24 hrs and 48 hrs.[33]

Withania sominifera commonly known as *Ashwagandha* contain pharmacologically active compounds Withanolide, which is basically steroid lactone and various types have been isolated from plant. In the Indian System of Medicine, *Withania somnifera* finds application for numerous ailments including inflammation. The plant also reported to have antistress, antioxidant, immunomodulatory, hemopoietic, and rejuvenating properties. Antiinflammatory activity was seen in methanolic fractions of *Withania* aerial parts, comparable to hydrocortisone; probably the activity was attributed to presence of biologically active steroids in the plant, of which withaferin A is known to be a major component

The standardized root extract of *Withania somnifera* find useful applications against the intracellular pathogens and in the management of immune suppressed diseases. Immunomodulatory activity of *Withania somnifera* was studied and found that it prevented myelosuppression and significantly increased the hemoglobin concentration. RBC, WBC count, platelet count and body weight in mice.

Administration of an extract from the powdered root of the plant *Withania somnifera* was found to stimulate immunological activity in mice. Treatment with five doses of *Withania* root extract was found to enhance the total WBC count on the 10th day. Bone marrow cellularity (27×106 cells/femur) as well as α-esterase positive cell number (1800/4000 cells) also increased significantly after the administration of *Withania* extract. Treatment with *Withania* extract along with the antigen (SRBC) produced an enhancement in the circulating antibody titre and the number of plaque forming cells (PFC) in the spleen. Maximum number of PFC (985 PFC/106 spleen cells) was obtained on the fourth day. Administration of *Withania* extract also showed an enhancement in phagocytic activity of peritoneal macrophages when compared to control in mice. These results confirm the immunomodulatory activity of *Withania somnifera* extract, which is a known immune modulator in indigenous medicine.[34]

Ocimum sanctum has ability to modulate humoral immune responses by acting at various levels in immune mechanism such as antibody production; release of mediators of hypersensitivity reactions and tissue responses to these mediators in the target organs.[35] Methanol extract and aqueous suspension of *Ocimum sanctum* leaves have ability to stimulate humoral response.[36] *Ocimum sanctum* seed oil also has been proved to modulate both humoral and cell mediated responsiveness in both non-stressed and stressed experimental animals and mechanism behind these immunomodulatory properties could be due to their activity on GABAergic pathways.[37]

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Glycyrrhetinic acid is isolated from *Glycyrrhiza glabra*. Glycyrrhetinic acid reported to show a promising anti-inflammatory action, inhibit the release of histamine, serotonin, and bradykinin and lowers vascular permeability. It is also reported to inhibit formalin-induced edema formation, granuloma weight and exudate amount. It has been reported that glycyrrhetinic acid produces protection against lung inflammatory diseases by producing anti-inflammatory chemokines, IL-8 and eotaxin 1 from lung fibroblasts, by which neutrophils and eosinophils are strongly attracted during inflammation. Glycyrrhetinic acid acts similar to cortisone and useful for all sorts of inflammation. It has an anti-inflammatory or allergic action by the suppression of PAF production. Glycyrrhetinic acid has a reputation as an excellent expectorant in the case of lung congestion and pharmacological studies indicate that it has sodium-retention, antidiuretic and anti-inflammatory actions. It accelerates lymphocytic transformation activation of macrophage and increases the leucocyte count.[38,39]

A controlled clinical study with combination of four important *Rasayana* drugs viz. *Guduci (T.Cordifolia), Ashwagandha (W.Somnifera), Amalaki (Emblica officinalis)* and *Tulasi (Ocimum sanctum)* in equal amounts was found to potentiate both the cellular and humoral components of immunity (Chatterjee S. & Das S.N., 1996). It significantly increased the microbicidal activity of the neutrophils and circulating levels of globulins and other components. It also significantly elevated the number of lymphocytes along with improvement in T-cell memory. The macrophage function study showed a significant increase in cell size, number of cells and phagocytic activity of macrophages with the administration of this combination. Chemotactic assay for phagocytic cells indicated positive chemo taxis for leukocytes.

The combination was found to potentiate the immune status and helped in faster recovery when used as an adjunct to specific therapy in cancer, chronic wasting diseases, multidrug resistant tuberculosis and other immunocompromised conditions.[40,41]

Analysis of the Indian government's Ayurvedic immunity - boosting measures for the COVID-19 crisis has been done in a study and following possible mode of action has been proposed.[42]

Intervention	Potential psychoneuroimmune mechanism	Meaning response
Drink warm water throughout the day	-	For cleansing the body
Daily practice of yoga	Evidence of monoamine & gamma amino butyric acid neurotransmission & alleviation of depression in controlled trials	Seen as an essential part of nutrition and health promoters
Use of specific species - turmeric, coriander, cumin, garlic	Evidence of monoamine &gamma-aminobutyric acid neurotransmission & alleviation of depression in controlled trials	Seen as an essential part of nutrition and health promoters
Take *Chyawanprash* (a traditional *Ayurvedic*preparation) every morning	Via evidence of reduction of depression and anxiety in controlled trials	Seen as rejuvenating the body
Drink herbal tea made from *Tulsi,* cinnamon, black pepper, ginger, raisins	Via evidence of reduction in depression, anxiety and stress controlled trials	Seen as a specific remedy for cough and respiratory problems
Nasal application- apply sesame oil/ coconut oil or ghee (clarified butter) twice a day		Seen as healing substance and a coolant for the body

CONCLUSION

As the various pathological organisms invading the human body has to come across defense mechanisms of our body. Our first line of defense consists of innate

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immune system. It consists of skin, mucus membrane, macrophages and natural killer cells and different proteins and enzymes.[43] Alveolar macrophages, a type of white blood cells on the surface of alveoli are another defense mechanism for lungs. Because of the requirement of gas exchange alveoli are not protected by mucus and cilia. Mucus is too thick and would slow down movement of oxygen and CO2. Instead alveolar macrophages seek out deposited particles, bind to them, ingest them, kill microorganisms and digest them.[43] Hence our immune system has a very important role in the prevention of disease progression. If the immune system becomes weaker, the host will not be able to produce enough macrophages and hence more susceptible to infections. Some Ayurvedic drugs promote immunity through various mechanisms as proved by some of the recent researches. As the cases of novel coronavirus is increasing with a very wide range in severity of clinical symptoms. Corona virus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. As people with these diseases have less efficient immune system as compared to healthy individuals this imposes that our immune system plays a key role in progression of diseases. So Ayurvedic measures can be used to reduce the burden of severity of disease on our society.

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