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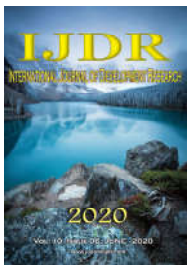

RESEARCH ARTICLE OPEN ACCESS

RATIONAL AYURVEDIC APPROACH TO MANAGEMENT OF COVID-19

Dr. Yogesh Kumar Pandey[1*], and Dr. Mansi Grewal[2]

[1]Associate Professor, Department of Kayachikitsa, CBPACS, New Delhi-110073
[2]PG Scholar, Department of Kayachikitsa, CBPACS, New Delhi-110073

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Corresponding author: Dr. Yogesh Kumar Pandey

ABSTRACT

Coronavirus disease 2019 is an ongoing public health emergency, in the form of a pandemic, due to a novel cause. While the treatment of this illness is being sought rigorously worldwide, Currently there is no established cure for it. Elaborate understanding of COVID-19 through roga pariksha (~examining and analysing the disease) methods as described in literature of ayurveda, the traditional system of medicine of the Indian subcontinent, can prove a useful step in finding its cure. Ayurveda has a huge number of remedies, belonging to different class of agents such ojo vardhak, bala vardhak (~immuno modulators), bhutaghna and vishaghna (~antimicrobial), jwaraghna (~anti-inflammatory and antipyretics), including therapeutic modalities for complicated or refractory respiratory illnesses (~daruna shwasahara yoga). This article makes an attempt at describing clinical stages of COVID-19 through ayurvedic rationale as jwara prabhava (~mild illness), shwasa purvaroopa (~non-severe pneumonia), shwasa (~severe penumonia), pravriddha shwasa/daruna shwasa (~ARDS), whilst recognising the arishta lakshan (~fatal clinical features) and designing a reasonable step wise management protocol for each. Ayurvedic approach towards COVID-19 opens the door for multitude of promising therapeutic modalities, which can be used scientifically with proper assessment of outcome measures. While this approach seems logical and clinically relevant, ayurveda too has its strengths and limitations, just like any other field of science or non-science arena. While Vaidyas of olden times had a rational approach to work their way around certain limitations, the times have changed and overcoming the same in current scenario is yet to be warranted. Nonetheless, ayurveda is a perennial source of knowledge with a lot to offer that has the potential to restore mankind from state of dis-ease to that of a healthy ease.

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INTRODUCTION

Ayurveda is made up of two sanskrit words, ayu which entails coming together of body, senses, mind and soul and veda meaning knowledge, wisdom. Ayurveda is a perennial source of knowledge, known to mankind since several thousands of years, about cause, features and treatment of diseases, and ways to restore as well as promote health. As per ayurveda, the human body is kept functional by triad of interdependent, balanced yet dynamic state of three bodily humours, namely vata, pitta and kapha. Any derangement in homeostasis of these humours paves way for diseases. These bodily humours are called Dosha. When doshas get qualitatively or quantitatively deranged due to endogenous or exogenous factors, a pathological cascade begins and disturbs the harmony of bodily tissues(dushya) and a dis-ease is manifested. Coronavirus disease 2019 (SARS-Cov-2) is a contagious respiratory tract illness. It was identified post outbreak of pneumonia of unknown etiology on 19th December 2019 in Wuhan, China. World Health Organisation (WHO) coined the name of this illness as novel COVID-19 and declared it as a public health emergency of international concern on 30th January 2020. As on 27th May 2020, there were 5,488,825 total confirmed cases with 349,095 deaths, globally, reflecting a 6.3% mortality rate. The number of confirmed cases is rising exponentially on daily basis as there is no known cure for this illness. Preventive measures are the only apparent weapon in our arsenal to fight against this pandemic. While cure is being sought worldwide rigorously, Ayurveda, holds ample remedies which can be useful in treating COVID-19. It has been realized that course of this illness inside human body is largely decided by immune factors of those affected. Ayurveda has the potential to control this pandemic through treatment modalities bhutaghna, vishaghna(~antimicrobial), bala vardhaka (~immuno-modulatory), jwaraghna dravya (~anti inflammatory agents) activities, as either single or combined formulations that have therapeutic effect on respiratory system.

Novel corona virus (2019-nCoV):2019-n-CoV is also known as SARS-CoV2 due to its similarity to virus caused SARS (severe acute respiratory syndrome) outbreak (SARS-CoVs) in

2002. SARS-CoV-2 virus is single stranded positive sense RNA, belongs to the genus Betacoronavirus. It is enveloped, spherical, 60-140 nm in diameter with corona like spikes of about 9-12 nm. These spikes are responsible for attacking and initiating the infection in host cells.

Pathophysiology

Little is known about exact pathogenesis of COVID-19. The basic postulated pathophysiology is as follows.

Infection of upper respiratory tract with 2019-nCoV
↓
Lower respiratory tract infection
↓
Infected alveolar macrophages/local defense units and tracheobronchial/alveolar epithelium
↓
Local host defenses get overcome, Viral cytopathic effects
↓
Innate immunity has insufficient interferon response, Excess production of cytokines→ Unsynchronized pro coagulant and anticoagulant mechanisms →increased permeability of pulmonary capillary endothelium, protein rich exudate, intra-alveolar fibrin deposits
↓
Recruitment of adaptive immunity, ongoing cellular damage due to uncontrolled pro inflammatory host response
↓
Depletion of immune cells, dissemination of virus to other target organs
↓
Ongoing unchecked injury, acute respiratory distress syndrome
↓
Respiratory failure/Recovery/Fibrotic stage
Or
Sepsis/Septic shock
↓
Death

It can be seen that innate and humoral adaptive immunity prevent infection spread and cell-mediated adaptive immunity work towards clearing the infection through lysis of infected cells which act as reservoir of virus.6

Clinical features: As per WHO, the following clinical syndromes are associated with COVID-19.

1. Mild illness*:* Patients have uncomplicated upper respiratory tract infection with non specific symptoms like fever, fatigue, cough (with or without sputum), anorexia, malaise, nasal congestion, sore throat, dyspnea and headache. Patient may also rarely present with diarrhea, nausea and vomiting.

2. Pneumonia (non severe)*:* No signs of severe pneumonia and no need for supplemental oxygen.

3. Severe pneumonia*:* There is fever or suspected respiratory infection with respiratory distress problems like - respiratory rate >30 breaths/min; SpO2 ≤ 90% on room air. Chest imaging is often necessary to ascertain or rule out pneumonia.

Samprapti (~pathophysiology) of COVID-19:

Agantuja Nidaan (~causative agent)
↓
Lodging of agantuja nidaan in kantha (upper respiratory tract) and urah (lower respiratory tract) due to vyadhi prabhava (~disease specific features)
↓
Kinchita kaala (~incubation period), Vishesh vyatha (~obscure, disease specific features)

4. Acute respiratory distress syndrome (ARDS): Onset is within one week of identified clinical illness or new development/worsening of respiratory symptoms. It is apparent on chest imaging as bilateral opacities not explained by fluid overload, lung collapse or nodules.

5. *Sepsis*: Multi organ dysfunction due to abnormal and unchecked host response towards suspected or proven infection. Signs of organs dysfunction are altered mental status, breathing difficulty, low oxygen saturation, tachycardia, oliguria, cold extremities; low blood pressure and weak pulse.

Septic shock*:* Hypotension not responding to fluid resuscitation, require use of vasopressors.

The clinical features of COVID-19 were first reported by Huang *et al*. (2020) in 41 patients (30 males and 11 females). Among these, 98 % patients showed fever, cough in 76%, dyspnea in 55%, myalgia or fatigue in 44%, sputum production in 28%, headache in 8%, hemoptysis in 5% and diarrhea in 3%. All the 41 patients had a common symptom of pneumonia with abnormal findings on Chest CT. Amongst these 41 patients, 29% progressed to ARDS, 15% had acute cardiac injury, 10% had secondary infection. However, 13 of 41 patients (32%) showed multiple complications and were admitted to ICU, of which later six patients (15 %) died. Most prevalent co morbidities as per results of meta analysis including 1576 patients were hypertension (21.1%), diabetes mellitus (9.7%), cardiovascular disease (8.4%), respiratory system disease(1.4%).

Diagnosis: Real-time reverse-transcription polymerase chain reaction (rRT-PCR) assay is used to diagnose the virus in respiratory samples.

Management: A few vaccines are undergoing human trial, but no confirmed cure of COVID-19 is in hand yet. Mild form of disease can be managed symptomatically along with isolation and monitoring for worsening of symptoms if any. Severe cases require hospitalization, oxygen therapy, understanding co-morbidities and simultaneously treating co-infections, if any. In acute respiratory distress syndrome, advanced oxygen or ventilator support is needed; along with therapeutics to prevent local and systemic complications. Septic shock requires cautious fluid resuscitation, vasopressors and inotropes; depending upon patient condition. Use of antipyretics, empiric antibiotic treatment for co-infection based on regional susceptibility-resistance patterns, neuraminidase inhibitor if seasonal influenza is prevalent are generally recommended for combating COVID-19.

Ayurvedic perspective

Janpadodhwansa*:* Pandemic/Epidemic is seen affecting a population at large, despite differences in people's bodily constitution, food habits, strength, immunity, habituation, status of mental strength and age. The presence of common environmental factors shared by the population such as air, water, land and time, assist in spread of the disease. Root cause of janpadodhwansa is adharma (~unethical practices), in the form of pragyapradha (~ knowingly doing something wrong despite being aware of its probable or certain ill-effects).Janpadodhwansa can manifest in the form of a highly contagious agantuja vikara (~accidental diseases; illness initiated by foreign factors that are not a part of human body). Initial samprapti(~pathophysiology) of such illnesses is vishesh (~different from that of diseases of internal origin).

↓
Development of agantuja jwara(~fever of exogenous origin)
↓
Jwara prabhava (~expression of specific features of Jwara) -santaapa (~raised temperature), aruchi (~anorexia), angmarda (~lassitude and myalgia)
↓
Jwara is a bala-hrasakara disease(~affecting immunity and general body strength)
↓

Sleshmika oja kshaya/apara oja kshaya (~deranged immune function, depletion of immune cells)

{Kanth is one pranayatana (seat of life), Urah is place of prana vayu, udana vayu, kapha and vital organs. Vitiation of residing place of doshas (~bodily humors)results in derangement of said dosha due to ashraya-ashrayee bhava (~interdependence between bodily humors and tissues). }

↓

Aggravated prana-udana vayu dislodge kapha from its usual place in chest.

↓

Resultant obstruction of path of vata; simultaneous pitta involvement apparent due to ongoing Jwara(ushma pitaadrite na asti, jwaro na asti ushmna vina)

↓

Obstruction in route of prana (~inward movement of air) and udana vata (~outward movement of the air) at gross & cellular level paves way for respiratory illness by causing ventilation-perfusion mismatch (praanasya vilomatvam shwasanam poorva lakshanam)

↓

If untreated; Doshachyavan(~instable movement of bodily humors) and kriyasannirodha(~hampered normal functioning of body) occur due to oja visranasa (~quantitatively and qualitatively vitiated elixir of life). It leads to disease progression and manifestation of Shwasa(~quickly progressive respiratory illness.)

↓

Ashukaari roga(~speedy progression of disease)

↓

Arishta lakshana(~fatal clinical features)

↓

Marana (Death, due to unmanaged Jwara and Shwasa, and resultant depletion of Oja.)

Stage wise samprapti ghataka (~components of pathophysiology), as understood by currently available knowledge on COVID-19 and basic principles of ayurvedic science

Mild illness (Jwara prabhava):

i. **Dosha (~corporeal humours)** – Alpa dosha bala(~low strength of disease causing factors), pitta-kaphaja if diarrhea or sore throat and vata kaphaja if dry cough & dyspnea
ii. **Dushya (~tissue factors)-** Rasa (~plasma), rakta (~blood), sleshmika oja/apara oja(~lymphatic fluid)
iii. **Adhisthana(site of pathogenesis**) – Kantha(pranayatana)(~throat); rasavahi dhamnis (~plasma carrying blood vessels), hrudaya (~heart), mahasrotas (~GIT)
iv. **Agni (~metabolic factors)**–Vishama(~irregular), manda (~inhibited/decapacitated)
v. **Srotodushti (~microchannels)** – Sanga(~obstructed)
vi. **Status of Oja (~immunity) -**Initial stage of ojo kshaya (~loss of immunity) later on beginning of visransa (~deranged activity of immune mechanisms.)
vii. **Upshaya (~disease attenuating modality)** - Bala vriddhi kara aushadh,ahara,vihaara. (~immuno modulator drug, diet, activity and therapeutic protocol) Jwaraghna (~antipyretic, anti inflammatory agents)vishaghna treatment (~anti-toxin treatment, use of antimicrobial agents).

Pneumonia (non severe) (Shwasa purvaroopa):

i. **Dosha (~disease causing endogenous factors)** - Madhyama dosha bala, (~medium/intermediate strength of disease causing factors) vata kapha pradhan alpa pitta tridosha (~aggravation of all three bodily humors with predominance of vata & kapha). Prana and udana vayu dushti apparent (~disturbance in normal functions of prana and udana vata).
ii. **Dushya (~tissue factors) –** Rasa (~plasma), rakta (~blood), lasika (~lymph, discounting its immune factors), sleshmika oja/apara oja.(lympathic fluid)
iii. **Adhisthana (~site of pathogenesis)–** Urah (~chest/lungs), kantha (~throat), amashaya/mahasrotas/pranavaha srotas. (~GIT & respiratory system).
iv. **Agni (~metabolic factors)**–Vishama (~irregular), Manda (~inhibited).
v. **Srotodushti (~effect on microchannels)** - Sanga (~obstructed), Vimargamana (~contents transgressing their physical or physiological limits), kapha uddhuyan (~excessive secretion of phlegm) due to deranged vata, exudation and fluid collection in intra alveolar space.
vi. **Status of Oja (~immunity)-** Stage of ojo visransa (~derangement), sandhivishleshan (~causing increased capillary permeability), dosha chyavanam (~apparent as chaotic and instable status of doshas), kriyasannirodha (~loss of normal functioning) of involved dosha (~innate immunity) and dushya (~tissue factors) disturbing normal healthy state and hampering body's ability to repair and return to homeostasis.
vii. **Upshaya (disease attenuating modality) -** Kapha vataghna (~Anti kapha & anti vata agents), ushna (~hot in potency), vatanulomana (~drugs that ensure normal movement of Vata) to remove obstruction in channels.

Pneumonia (severe) (Shwasa roga):

i. **Dosha (~pathological factors)** - Vata kapha pradhana tridosha (~aggravation of all three bodily humors with predominance of vata and kapha), dosha bala adhika(~increased strength of pro disease factors), rogi bala alpa (decreased immunity)- leads to disease progression.
ii. **Dushya (~tissue factors) –** Rasa (~plasma), rakta (~blood), lasika, sleshmika oja (~lymphatic fluid).
iii. **Adhisthana (~site of pathogenesis)** – Pranavahasrotas (~gaseous exchange sytem/respiratory system), urah (~chest), kantha (~throat), amashaya (~upper GIT).
iv. **Agni (~metabolic factors**) – Manda (~inhibited)
v. **Srotodushti (~effect on channels of circualation**) – Sanga (~obstructed), vimargaman (~physical/physiological transgression of contents of microchannels to other sites)
vi. **Status of oja (~immunity)-** Ojo vyapata(~second stage of derangement in immune status). Varna bheda(~ loss of complexion, cyanosis, ?discoloration in tissues affected by disease pathogenesis)
vii. **Upshaya (~disease attenuating modality)** – Ashukari (~acute/urgent) management of shwasa.

Acute Respiratory Distress Syndrome (Pravriddha Shwasa):

i. **Dosha(~endogenous pathological factors) -** Vata pitta pradhana tridosha(~aggravation of all three bodily humours with predominance of vata and pitta),
Dosha bala adhika(~increased strength of pro disease factors), rogi bala alpa(~depleted strength of patient); it

leads to ashukari praanoprodhi vyadhi(~rapid progression in severity of disease).

ii. **Dushya (~tissue factors) –** Phuphusa(~lung) is affected as diffuse alveolar damage is characteristic of ARDS, rasa (~plasma), rakta(~blood), lasika(~lymph), sleshmika oja (~lympathic fluid, tissue and circulating immune factors).

iii. **Adhisthana (~site of pathogenesis**) – Pranavahasrotas (~gaseous exchange system/respiratory system), urah (~chest), kantha(~throat), amashaya(~upper GIT).

iv. **Agni (~metabolic factors) –** Manda(~inhibited)

v. **Srotodushti (~effect on channels of circulation)** - ?Atipravritti (~overzealous and dysregulated host response) seen as uncontrolled vicious cycle of increasing inflammation and pulmonary damage). Vimargamana (~physical/physiological transgression of contents of microchannels to other sites).

vi. **Status of Oja (~immunity) :** Ojo vyapat(~second stage of deranged immunity) bordering to ojo kshaya(~final stage of deranged immunity) seen as glani(~weakness), tandra (~sluggishness), moha(~confusion, ignorance).

vii. **Upshaya (~disease attenuating modality)** - Stambhan upkrama?(blocking/astringent therapy) to limit the potential of damage caused by excessive pitta(~pro inflammatory host response) and visha(~toxins, viral cytopathic effects)?. Use of daruna shwasahara formulations (~therapeutics for refractory/complicated respiratory illness).

Sepsis and septic shock (Arishta lakshana?):

i. **Dosha (~corporeal humours) -** Unstable involvement of tridosha.

ii. **Dushya (~tissue factors)** - Whole body, primarily marma (~vital organs) and gambhira dhatus (~deeper tissues).

iii. **Adhisthana (~site of pathogenesis)** -Whole body, pranayatana (~seat of life) including marma (~vital organs).

iv. **Agni (~metabolic factors) –** Manda (~inhibited).

v. **Sroto dushti (~effect of channels of circulation) –** Vimargamana (~physical/physiological transgression of contents of microchannels to other sites),

vi. **Status of oja (~immunity)** - Ojo kshaya(~final stage of derangement in immunity).

vii. **Upshaya (~disease attenuating modality)** - Presence of fatal signs, pratyakheya (~explain the prognosis to patient's attendants (,and refer the patient due to ethical reasons).

***Role of trividha bala*:** Trividha bala (~three types of bodily strengths) constitutes sahaja, kalaja and yuktikruta bala. Sahaja bala is the one which is present since birth, even during intra uterine life. Its role can be seen like that of innate immune responses. Kalaja bala (~varying with time and age) and yuktikrutbala (~acquired through intake of desired and relevant food, medications and other interventions) are equivalents of acquired immunity and physical strength, these are subject to variation, hence are potential targets of therapeutic intervention.

Ayurvedic counterpart of clinical features of COVID-19: Patient can present with santapa/jwara (~fever), kasa (~cough), shwasa krichrata/swasa (~dyspnea), angmarda-klama-glaani(~lassitude, myalgia), shtheevan/kapha yukta kaasa (~excessive salivation, productive cough), shirashoola/shirograha (~headache), rakta shtheevan (~hemoptysis), atisaara/varch bheda (~diarrhea), marmopghata (~vital organ involvement like heart, kidneys, brain), ?angavdarana (~organ damage?, alveolar damage in lungs) due to involvement of pitta18, arishta lakshana(~fatal signs).

Arishta lakshana (~fatal signs) of Jwara are as follows :

- Nipattito, visangya shete - Poor glassgow coma scale.
- Sheetardito, antar ushna, hrishta roma, pipasa - Septic shock with ongoing sepsis causing cold extremities.
- Hridi sanghaat shoola - Critical cardiac injury; cardiac arrest
- Nitya vakraochhwas, santat uchhwasa - Severe respiratory distress leading to respiratory failure.
- Hata prabha, hata indriya - Irreversibly altered sensorium and lustre.

These fatal signs are reflective of end stage of illness, in which damage to critical organs is irreversible and grave . Nipattito, visangya shete; hata prabha, hata indriya indicate injury to nervous system. Hridi sanghaat shoola is seen in irreversible cardiovascular injury, and nitya vakraochhwas, santat uchhwasa points toward impending respiratory failure. Ongoing sepsis and the hampered perfusion of end organs causing permanent damage manifest as sheetardito, antar ushna, hrishta roma, pipasa.

Rationale of curability/non-curability at various stages in view of ayurvedic principles

***Sukhasadhya (~easily curable)*:** Mild illness (~jwara prabhava), Pneumonia (non-severe) (~shwasa purvaroopa).
Reasoning - Non chronic, mild clinical features with no complication, non-involvement of vital points/organs.
Patient is able to digest all indicated medicines & tolerate procedures.

Krichhrasadhya (~curable with difficulty): Pneumonia (severe) (~shwasa roga), ARDS (~pravriddha shwasa)

***Reasoning*:** Shwasa is ashukari (rapidly progressive) illness. Moderate clinical features with minor complications. Need of shastra prayoga (~surgical management; equivalent to use of intensive invasive procedures like endotracheal intubation and mechanical ventilation).

***Yapya (~incurable yet manageable)*:** ARDS in fibrotic and post fibrotic state. (~?urah shushkta due complication of shwasa). Reasoning - Irreversible fibrotic changes, symptoms are only manageable with consistent pathya sevan (~exposure to and consumption of health promoting factors). Apathya sevan (~usage of harmful and contraindicated substances) causes easy relapse of dyspnea &exacerbation in view of decreased lung function.

Pratyakheya (~incurable, terminal?): Sepsis and septic shock (~arishta lakshana). Reasoning - Sarva marga gata (~disease in all three pathways), presence of fatal features.

Treatment principles in Ayurveda

Mild illness - Along line of management of agantuja jwara(~fever of exogenous origin). Fasting should be avoided. Modalities of treatment at this stage are

i. Parisheka(~fomentation by showering)
ii. Mantra(~motivating chants)
iii. Vishaghnatherapies (~antimicrobial, detoxifying treatment).
iv. Oja vriddhi (~immunity enhancement).

Pneumonia (non-severe) - Clearing srotorodha (~obstruction in channels) using vata-kaphahara drugs for avyahata gati(~natural movement and status) of doshas. Purification therapies of vamana (~therapeutic emesis) or virechan(~therapeutic purgation) if patient's vitals are stable with no co-morbidities.

Pneumonia (severe) – Ashukari (urgent) treatment needed. Vata-kaphaghna (vata and kapha pacifying action), ushna (hot in potency), vatanuloman (drugs promoting normal movement of vata). If patient with replete strengthand kapha dominance, no comorbidities and not in extremes of age: Lehan (~lickable formulations, oral drugs), dhoopan (~fumigation). If patient has depletedstrengthand vata dominance: Tarpana (~libation, nutritional enhancement), shaman (~alleviation) with sneha, yusha, rasadi. Alternating shaman (~alleviation) and bruhan (~ nutritive) therapy are indicated.

ARDS (~pravriddha shwasa): Refer the patient for emergency treatment as paradhikara patient (~belonging to expertise of other speciality); invasive procedure is needed. Daruna shwasa hara yoga (~drugs for refractory and complicated respiratory illness)can be administered once patient has stabilized, to promote recovery of lung function and prevent relapse/ exacerbations in future. Sepsis and septic shock - Fatal features present. For ethical purpose, refer the patient for urgent, intensive and invasive management in paradhikara.

Ayurvedic treatment protocol enlisting first priority drugs/therapeutics for each stage

Stage	Therapeutics with rationale
Mild illness(~Jwara prabhava)	a)Dhoopan(~fumigation) with Haridra+Eladi gana. (Vishaghna) b) Balvardhan(~immunomodulation) and bruhan(~nutritive therapy) with Yashtimadhu, Karkatshringi, Guduchi, Kutki, Bala, Shatavari, Ashwagandha. c) For jwaraghna action decoction made from contents of Amalakyadi gana (indicated in all kinds of fever, it is deepana(~promoting metabolism) and , arocakaghna(~appetizer) for oral intake and and showering.
Pneumonia(nonsevere) (~Shwasa purvaroopa)	a) Fumigation with Haridra+Eladi gana. Swasahara treatment principles for maintaining bodily strength (immune and physical) of patient and removing obstruction of channels : b.) Tarpana of durbala rogi with Tryaushnadi ghrita. Followed by swedan (~sudation) (unless contraindicated) using dashmoola kwath. Do mridu upnaha sweda (~mild localised sudation)with utkarika (~poultice) if benefits outweigh risks. c.) Vamana if kapha predominant dosha: of balwan rogi, or of durbala rogi post tarpana with Pipplai+Saindhava+Madhu. d.) Post vaman, do abhyanga (~oil massage) with chandanadya taila to prevent aggravation of vata. e.) Shamanoshadha (~palliative therapy)for shwasa post therapeutic emesis : Dashmoola kwath, Haridradi churna.
Pneumonia(severe)(~Shwasa roga, ashukari(quickly progressive disorder)	a)Dhoopan (~fumigation) with Haridra+Eladi gana+ Manashila. Or Dhoopan with Dhatoor-panchanga. b) Shwas kuthar rasa , Indravarunikadi churna (acts on urdhwa shwasa (~?obstructive respiratory illness)) If cardiac comorbidity presents: Use Nagarunabhra rasa instead of Shwasa kuthar rasa. Nagarjunabhra rasa is balya(~strength promoting), vrishya(~improves virility), rasayana(~rejuvenating); combats hridroga(~cardiac illness), urah kshat(~sequelae of injury to contents of chest cavity), kshya(~debilitating illness), shotha(~edema), visham jwara(~abrupt fevers). Monitor patient for worsening of symptoms and lack of response to treatment; immediately refer the patient for invasive procedure and therapy if paradhikara(~belonging to expertise of other speciality) features are seen.
ARDS - Acute Respiratory Distress Syndrome(~Daruna Shwasa)	a.) Fumigation with Haridra+Eladi gana+ Manashila. b.) Use of Darun shwasa hara agents(~for refractory/complicated respiratory illness) : Kshaar leha of Ashwagandha kshaar with madhu+ghrita. c.) Shringyadi churna (For acute shaman(~attenuation)of shwas caused by ati ugra dosha(~chaotic bodily humors). d.) For management of urah shushkata(~ post fibrotic state of lung in ARDS survivors) : Dashmooladi ghrita or Triushnadi ghrita. e.) ?Stambhana (~blocking/astringent therapy) to attenuate atipravritti(~vicious cycle of lung injury and inflammation).[23] *Limitations of b to e : Lack of parenteral route of administration of ayurvedic drugs in critically ill patients who cannot take drugs orally.
Septic shock(~arishta lakshana manifest)	Incurable when arishta lakshan(~fatal features)manifest. For ethical purposes, refer the patient to relevant paradhikara. Logically promising ayurvedic principles to prevent progression to fatal stage are : a.)Abhyantara daha nashan? (~controlling aggressive inflammation and resultant organ damage) to control ongoing sepsis with Rasanjan, Madhuyashti, Priyangu. b.) Stambhana therapy. Limitation to use of these principles.* Measures to counter unconsciousness (~murchha): a.) Nasya(~nasal administration) with Ardraka swarasa b.) Anjana (~therapeutic collyrium) of Saindhav lavana+Manashila+Maricha all mixed with madhu. c.) Fumigation with aromatic and soothing agents (drugs of eladi gana).

Ayurvedic class of therapeutic agents for treatment of COVID-19

1. **Balvardhaka(~strength promoters, immunity enhances)**: Kakolyadi gana, Laghu manchmool. Balya mahakashaya
2. **Vishaghna(~antimicrobials)** : Aragvadhadi gana, Shyamadi gana, Eladi gana, Patoladi gana, Anjanadi gana, Utpaladi, Sursadi(krimighna). Vishaghna mahakashaya.
3. **Jwaraghna(~antipyretic, antiinflammatory)**: Aragvadhadi gana, Patoladi gana, Guduchyadi gana, Amalakyadi gana (sarva jwara), Dashmoola(sarva jwara). Jwarahara mahakashaya
4. **Shwasahara(~drugs for quickly progressive respiratory illness)** : Vidarigandhadi gana(urdhwa shwasa), Sursadi gana, Dashmoola. Shwashara mahakashaya.
5. **Vata-kapha hara(~drugs balancing vata and kapha humours)** : Eladi gana, Brihat panchmoola, Dashmoola(tridosha nashak)
6. **Daha nashan(~?coolants, ?antiinflammatory)-** Anjanadi gana(rasaanjan, priyangu, yashtimadhu forabhyantara daha in septic shock?). Dahaprashman mahakashaya.
7. **Daruna shwasa hara(~drugs for complicated/refractory respiratory illness)[20,29]** : Ashwagandha kshaar lehan with madhu-sarpi, Kushmanda churna.
   Drugs given in Shushka urah(? fibrosis after ARDS resolution) : Sarpi. Triushnadi ghrita, dashmooladi ghrita.[20]
8. **Dhoopan(~Fumigation)[20]** : Haridra, Tejapatra, Eranda moola, Laksha, Manashila, Devdaru, Hartala, Jatamamsi; Yava churna with ghrit.

Do's and don'ts for COVID-19 patients as per Ayurvedic principles

In jwara predominantstate of illness - Avoid langhana(~therapeutic fasting),; use ojo vardhak aahara-vihara(~immunity promoting diet and regimens), vishghna(~antimicrobial, antitoxic) measures and do sadvritta palana(~follow code of right conducts). In shwasa predominant state of illness - Avoid supression of natural urges; avoid eating tubers, mustard, fish, dry and heavy diet with cold potency, prevent exposure to excess sunlight and pollution. Use vastuka, vartaka, patola, ela, haritaki, jambiri, matulunga, rasona, draksha, trikatu.

Limitations of Ayurvedic interventions.

1. Questionable potency of available drugs, due to their decreased guna (~quality) when collected in time of janpadodhwansa.
2. Non-availability of parenteral route of drug administration pushes ayurvedic formulations to backseat in critical times when invasive interventions are needed.
3. Non-palatability of some drugs leads to non-adherence and non-compliance from patients.

Outcome measures to assess effectiveness of Ayurvedic protocol.

1. Presence of Jwara mukti lakshana (clinical features reflecting subsidence of fever/inflammation)
1. Vigata klama (~absence of lassitude), Vigata santapa(~normal body temperature), Avyatha-vimala indriya(~absence of irritability and intact nervine functions), yukta prakriti(~ presence of feeling of well being with normal quality of life).
2. Duration from start of treatment to normalization of pyrexia, SpO_2, respiratory rate, relief of cough, relief of dyspnea.
3. Time from start of treatment to negativity in rtPCR.
4. ICU admission rate, mortality - within 4 weeks.
5. Assessment of CRP.

Conclusion

COVID-19 is a viral illness that manifests a clinical picture of varied presentation and severity. The impact of SARS-CoV2 on health of patients depends on viral cytopathic effects and host responses. While rigorous research and ample resources are being used in trying to make an effective therapeutic modality to combat COVID-19, a quick response is being sought to contain the spread and reduce disease burden. The prompt answer to this may be hidden in pre-existing ayurvedic knowledge. Understanding this illness through ayurvedic principles opens the door towards multitude of rational therapeutic agents which can be used scientifically, with proper assessment of outcome measures. Designing a stage wise, patient specific, ayurvedic management protocol of COVID-19 appears to be a promising approach. Use of balya (~strength promoters), ojo vardhaka(~immune enhancers), bhutaghna(~antimicrobial), vishaghna(~antimicrobial, anti toxins) and jwarahara(~antipyretic, anti-inflammatory) agents early in the course of illness may limit or slow disease progression by increasing viral clearance and enhancing immunity. For respiratory illness, prompt and judicious use of shwashara modalities (~acting on respiratory system) may prove clinically beneficial by aiding repair of ongoing respiratory damage, strengthening local defenses and assisting in restoration of ventilation-perfusion ratio.

Just like any other field of science or non-science arena, ayurveda too has its strengths and limitations. Even though the knowledge in ayurveda is ample, there are certain roadblocks to clinical application of that knowledge which are yet to be overcome. Lack of parenteral route of drug administration in critically ill patients is one such limitation. While nasal administration, therapeutic collyrium, fumigation with aromatic agents maybe the answer to that limitation in current scenario, further studies are needed to warrant that. Nonetheless, ayurveda is a perennial source of knowledge with a lot to offer that has the potential to restore mankind from state of dis-ease to that of a healthy ease.

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