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PICTORIAL ORIGINAL PAPER

SARS-Cov-2 (human) and COVID-19: Primer 2020

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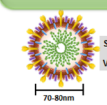
SARS-Cov-2 (human) , COVID-19 and Covidism: Primer 2020

Brief: The human coronaviruses have a history of causing pandemics with respiratory syndromes, like Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). The recently emerged novel coronal virus, SARS-Cov-2 has caused global pandemic which is still going unabated even as we write this piece. To understand SARS-Cov-2 and its associated disease COVID-19 it is extremely important to understand the biology of the virus, its origin, its genome, together with its clinical and epidemiological impacts. The brief primer provided below is a snapshot of the key published information (and also from preprint servers) to portrait the virus, its biology and the disease by a graphical representation. The snapshot ends with a reminder that the pandemic disease has not only impacted on the working of various organ-systems of the human body, but also on the society at large in a new emerging wave of "Covidism".

SARS-Cov-2 Coronology

Family Name: Coronaviridae
Order : Nidovirales
Genus Name : BetaCoronavirus
The Provisional Name: 2019 Novel Coronavirus (2019-nCoV)
The Official Name: Sars-Cov-2
Misnomers: Manmade China-Virus
Date of Birth :November or December 2019,
Official Date of Isolation: Jan 7, 2020
Place of Origin: Wuhan , Hubei Province , China, **Locality:** Huanan Seafood Wholesale market
Disease : Coronavirus Disease 19 or COVID-19,
Closest Relative: Pangolin Cov (91.02%)
Other Relatives: SARS- Cov (79% similarity), MERS-Cov (50% similarity), SARS -Bat-SL-CoVZC45 (88% similarity)
Homing Residence: Type-II Pneumocytes, Lung
Roaming Address: Asia, Europe, North America etc
Gen Bank Number : MN908947 (NCBI, Wuhan-Hu-1 Isolate)
Contact Number: 1798172431 (General Information Number/GI)
(Ref. 1, 2)

SARS-Cov-2 : Coronomics



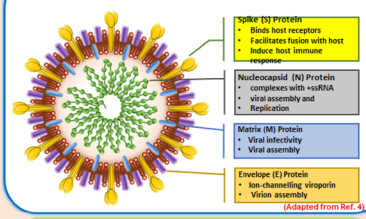
Shape : Spherical with Peplomeric structure
Viral Spike: 9-15nm
(Ref. 3)

SARS-Cov2: Genome

Genome : +ssRNA, positive-sense, single-stranded RNA viruses
Genome Size: approx 30Kb

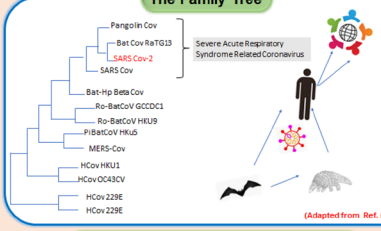
(Ref. 1)

SARS-Cov-2 : The Viral Armory



(Adapted from Ref. 4)

The Family Tree



(Adapted from Ref. 5)

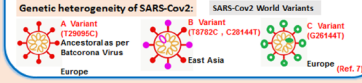
SARS-Cov-2 Avtars

SARS-CoV-2 viral strains :

Two different SNPs show nearly complete linkage across various viral strains and according to the polymorphic variant at position 28144 two major strains are defined:
L Strain: major type (~70%) : T28,144 Leucine : Possibly aggressive
S Strain : minor type (~30%) : C28,144 Serine : Ancestral

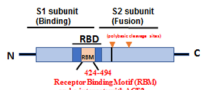
(Ref. 6)

Genetic heterogeneity of SARS-Cov2: SARS-Cov2 World Variants



(Ref. 7)

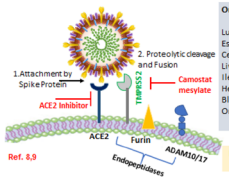
The Spike Protein (Corona)- Piercing Armor



- Spike protein is antigenic
- Antibodies against RBM region of Spike may offer protection
- Mutations in Receptor Binding Domain (RBD) of SARS-Cov-2 (2019) may make it more deadlier than SARS-Cov (2003)

(Ref. 8)

SARS-Cov-2 Host Entry Receptors



Ref. 8,9

Organs with high expression of ACE2

Lung : Type II pneumocytes
Esophagus: Upper Stratified Epithelial Cells
Liver : Cholangiocytes
Ileum and Colon: Enterocytes
Heart: Myocardial cells
Bladder: Urothelial cells
Oral cavity: Epithelial cells of Tongue
(Ref. 10)

Data till now indicative of viral replication only in lung

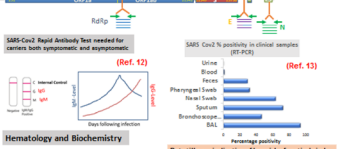
Clinical Conundrum

- Increased ACE2 expression in certain comorbidities may worsen prognosis with SARS-Cov2 infection
- Lisinopril , Losartan Thiazolidinediones , Ibuprofen — ↑ACE2 expression

SARS - Cov-2 and Clinical Findings

Laboratory Tests

Diagnostic detection by qRT-PCR (WHO approved)
Screening : E gene amplification
Confirmation: RdRp amplification
Additional Confirmation: N amplification
Ref. 11



Hematology and Biochemistry

CBC: ↓WBC, ↓PLT, lymphopenia
LFT: ↑ AST ↑ ALT, ↑Total Bilirubin
High SOFA score
d-dimer greater than 1 µg/ml

Data till now indicative of low risk of vertical viral transmission from mother to child.

Severe: ↑Troponin, ↑Myoglobin, ↑LDH, ↓Albumin, ↑Procalcitonin
(Ref. 14, 15)

SARS- Cov-2 and Prognosis

Pathological

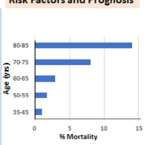
Lung:
- X-ray images : progression of pneumonia
- Interstitial mononuclear inflammatory infiltrates, dominated by lymphocytes,
- Multinucleated syncytial cells with atypical enlarged pneumocytes characterised by large nuclei, amphophilic granular cytoplasm, and prominent nucleoli in the intra-alveolar spaces, showing viral cytopathic-like changes

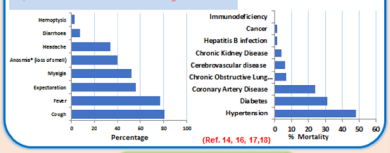
Liver
- moderate microvesicular steatosis and mild lobular and portal activity

Heart
- No substantial damage in the heart tissue

Hematology
- ↓ lymphopenia
- Overall decline CD4 and CD8 T cells but hyperactivated status
- HLA-DR (CD4 3-47%) and CD38 (CD8 39-4%) double-positives
- CD8T cells-Perforin and Granulysin positive (Cytotoxic) — immune injury
- CCR6+ Th17 CD4T

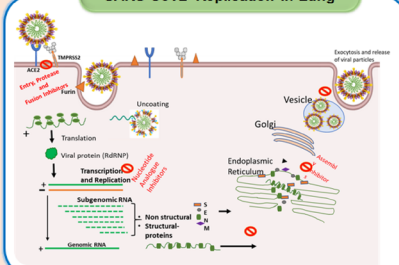
Risk Factors and Prognosis





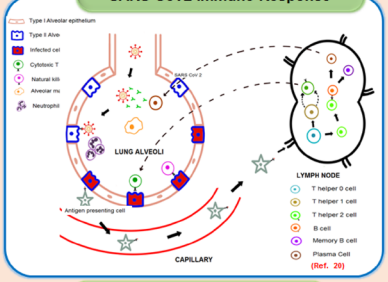
(Ref. 14, 16, 17,18)

SARS-Cov2 Replication in Lung



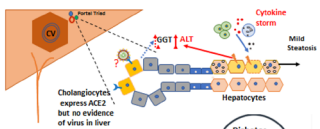
(Adapted from Ref.19)

SARS-Cov2-Immune Response

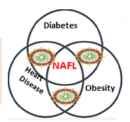


(Ref. 20)

SARS Cov-2 and Liver



- Associated comorbidities of NAFL make it a high risk group
- Liver injury mostly in severe Covid-19
- Screening of fecal microbiota donors
- Health advisory for Liver transplant subjects on immunosuppressants



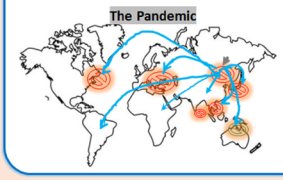
(Ref 21, 22)

From Covid-Biology to Covidism

Corona-Virometrics

Incubation period (Varied 4-24 days)
Viral Shedding
Viral shedding was 20·0 days (17·0–24·0), ranging from 8 to 37 days, but the virus was detectable until death in non-survivors.
Cov2 , Aerosol and Surface Stability
Aerosol – 3hrs Steel : 48hrs
Copper-4hrs Plastic : 72hrs
Cardboard-8hr
(Ref. 14, 23)

The Pandemic



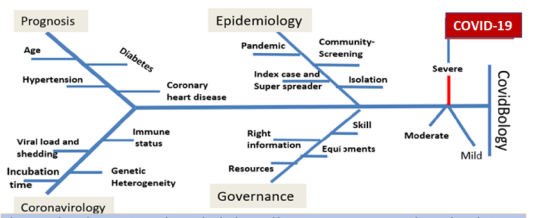
Suggested Therapies

- Chloroquine (low viral load)
- Hydroxychloroquine (low viral load, limited benefits)
- Azithromycin
- Tocilizumab
- Lopinavir/Ritonavir
- Remdesivir (Negative Trial)
- Convalescent plasma
- Vaccine (mRNA-1273, trails begun)
- human recombinant soluble ACE2

(Ref. 15, 24, 25, 26)

Corona-Questions:

- Why SARS-Cov-2 cannot effectively bind mouse ACE2, but has high affinity to human ACE2?
- Are there different strains/genotypes/quasispecies of SARS-Cov-2? Can it cause reinfection?
- What makes SARS-Cov2 more pandemic unlike SARS and MERS?
- Can extrapulmonary sites with ACE2 expression act as SARS-Cov-2 reservoir(s)?
- What is the impact of SARS-Cov2 on gut and the microbiome?
- How to identify asymptomatic and presymptomatic viral shedding for infection control measures? How long the SARS-Cov2 immunity lasts?
- What is an effective cure for Corona : drugs or vaccine?



The way to beat this virus is to understand its biology and how various agencies respond to viral pandemic to contain it.

The 30 kilobase genome of Rogue virus can be only conquered by the scientific intelligence of 3 billion nucleotide base pairs of human genome i.e. the mankind and its brave army of Covid warriors.

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