POST COVID 19 SCENARIO

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INDEX

POST COVID 19 PANDEMIC CLINICAL SCENARIO IN GOA

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Abstract
COVID 19 (SARS - CoV - 2)
Severe Acute Respiratory Corona Virus 2 has caused a Pandemic worldwide and changed the Health care. Disease profile and lifestyles across the globe.
These effects are due to
1 COVID 19 disease
2 COVID 19 carriers
3 Vaccinations
4 Long COVID 19 Syndrome
5 After effects and Complications of COVID 19 disease .vaccines and therapy.
COVID 19 Pandemic seen in Goa and India between January 2020 to January 2023 has faded away and left its indelible footprints in the sands of time.
The present Clinical Scenario .profile .landscape and canvas in the workspace of Goa Medical College has been studied in a multidisciplinary, multidirectional ,multispecialty fashion and has a multifactorial causality.
The salient aspects of COVID 19 .Vaccines .long COVID 19 Syndrome and the present clinical scenario are discussed with to repeat to various systems like Central Nervous System .Cardiovascular System .Respiratory. System. Endocrine .Autoimmune lesions .Skin .Gastrointestinal Tract .Eyes .joints .Obstetrics and Gynecology. Hematology .and effects in children and elderly.
Postmortem studies are also discussed.
The age, sex. Sites involved. Organs involved .the severity .the diversity. Imaging and Laboratory data are analyzed and discussed.

These effects could be transient .or temporary or permanent.
Further studies and ongoing studies will be conducted to evaluate the long term effects.
Madam Marie Curie said
Nothing in life is to be feared. It is to be understood. Now is the time to understand more so that we may fear less.
Finally there is light at the end of the tunnel.

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COVID 19 VACCINES AFTER EFFECTS

Severe Pathology
Mortality
Assoc. With COVID 19 Vaccination
Autopsies
Publications
Clinical data in GMC
Autopsies in GMC
Vaccines were rapidly developed and rolled out in less than 1 year
COVID 19 Pandemic Global
COVID 19 Vaccination Programmes
Global
Vaccine related deaths
Severe Clinico Pathological Complications of the vaccine
Autopsies conducted
Death within 3 weeks or 21 days of vaccination
AEFI
Adverse Events following Immunization
Types of COVID 19 Vaccines
1. Live attenuated virus
2. Inactivated virus
3. mRNA
4. Using Adenovirus vector
After effects
Anaphylaxis
Bells palsy
Immune thrombocytopenia
Capillary leak syndrome
Menstrual disorders
Local skin site delayed hypersensitivity
GB Syndrome
Swelling of the vaccinated limb
Facial swelling
Non fatal
Fatal
Serious
VITT
Vaccination Induced
Immune Thrombotic Thrombocytopenia
VITT

1 to 23 days post vaccine
ITP Immune Thrombocytopenia
Low platelet count
Mucosal bleeding
Thrombosis
Unusual locations
Not Deep Vein Thrombosis
Not Pul TE
Dural Venous Sinus Thrombosis
Sphlanchnic Hepatic vein
Splenic vein5 to 6 days post vaccination
DD
TTP
HIT
Anti-Phospholipid Syndrome
VTE
DIC cancer assoc.
Cerebral hemorrhage
Splenomegaly
Hepatomegaly
Renal glomeruli. Arteriolar thrombosis DIC
Coronary artery thrombosis .MI
VITT
Low platelet count
D Dimer high level
Low fibrinogen
High level of Antibodies against Platelet
Factor 4 PF 4
Myocarditis
Clinical
Cardiac Imaging
Dallas criteria
1. True Myocarditis
Myocyte necrosis or degeneration or both and assoc with
Inflammatory inf lymphocyrs .histiocytes mononuclear cells
Inf is severe
Seen in LP
2. Borderline Myocarditis
Mild interstitial inf and edema
No damage to myocyte

Myocarditis is due to SIRS
Systemic inflammatory Response Syndrome
No direct attack on myocyte
Fatal 2 new types Fatal
Fulminant Eosinophic Myocarditis
Cardiac reaction
Vasculitis
Cutaneous
GIT
Kidney
Multiorgan
Reactivation of latent varicella inf
Varicella zoster
Herpes zoster
Interstitial Lung Disease
Korea
Organs at Autopsy
Blood vessels
Brain
Dura
Lungs
Heart
Kidneys
Splanchnic visera
Clotting studies
10 billion doses of COVID 19 vaccines given worldwide
150 vaccine doses per 100 population globally
Complications no is miniscule
COVID19 positive patient given COVID 19 Vaccine

COVID AND THE ELDERLY

Dr.Edwin Gomes,
Professor & Head,
Geriatric Medicine, Goa Medical College.

- Elderly people are at a **higher risk** of COVID-19 infection due to their decreased immunity and body reserves, as well as multiple associated comorbidities like diabetes, hypertension, chronic kidney disease and chronic obstructive pulmonary disease. Also, course of disease tends to be more severe in case of elderlies resulting in higher mortality.
- **Stay at home.** Avoid meeting visitors at home. If meeting is essential, maintain a distance of one meter.

Ensure proper nutrition through home cooked fresh hot meals, hydrate frequently and take fresh juices to boost immunity.

Monitor your health. If you develop fever, cough and/or breathing difficulty immediately contact nearest health care facility and follow the medical advice rendered

Do not go to hospital for routine checkup or follow up. As far as possible make tele-consultation with your healthcare provider.

Don't go out unless it is absolutely essential.

Health Advisory for Elderly Population of India during COVID19

- https://www.mohfw.gov.in/pdf/AdvisoryforElderlyPopulation.pdf
- As expected, comorbidities were quite common in older adults.

Eight out of ten patients had at least one comorbidity with hypertension, diabetes, and cardiovascular disease being the most common.

This finding is important as the presence of comorbidities such as hypertension or diabetes is considered as a predictor of adverse outcomes in these patents.

- The most common symptoms seen in older patients were

fever (83%),
cough (60%)
and dyspnoea (42%).

- Lymphopenia (52%) followed by leukopenia (20%) were found to be quite common among the patients. Bilateral lung infiltrates (76%) was the most common radiological finding reported in older patients.

Dry cough (56%) was more common than the productive cough (28%).

However, while reporting cough, many studies didn't specify the nature of cough, thus these results should be interpreted with caution.

Gastrointestinal symptoms were also present with diarrhoea being the most common one.

- Lymphopenia (52%) followed by leukopenia (20%) were found to be quite common among the patients.
- Bilateral lung infiltrates (76%) was the most common radiological finding reported in older patients.

- Most common complication seen in these patients is secondary infection (34%) followed by AKI (22%) and
ARDS (20%).
- Of note, most of the patients
(84%) required oxygen support and a significant number of patients
(21%) required invasive mechanical ventilation.
A few of them (24%) were also on non-invasive ventilation.
- **Clinical features and outcomes of COVID-19 in older adults: a systematic review and meta-analysis**

Sunny Singhal, Pramod Kumar, Sumitabh Singh, Srishti Saha & Aparajit Ballav Dey
BMC Geriatrics
Volume 21, Article number: 321 (2021)

- According to research in China,

37.1% of seniors experienced symptoms of depression and anxiety during the COVID-19 pandemic
with those most vulnerable to the effects of depression and
anxiety being women,
those who are widowed, or divorced, live alone, have worse physical health or have sleep problems

- This problem of worsening mental health in the elderly due to social isolation is of particular concern for those with prior histories of mental health problems.
- Social network ties, social network structure, and participation in community events are demonstrated to help the mental health of older adults.
- Older adults who are socially isolated experience changes in their mood, cognition, and sensitivity to threats as well as disruptions in sleep, and older adults who feel alone report more depressive symptoms than their socially connected counterparts.
- Reports are emerging from India of cases of older adults with prior history of mental health disorders presenting to the emergency room with severe exacerbations of symptoms specifically attributed to social isolation and decreased access to mental health services during the COVID-19 pandemic.
- Moro T, Paoli A: When COVID-19 affects muscle: effects of quarantine in older adults. Eur J Transl Myol. 2020, 30:9069. 10.4081/ejtm.2019.9069
- PSYCHOLOGICAL PROBLEMS ASSOCIATED WITH COVID-19

written by Narayana Health May 14, 2020

- Moro T, Paoli A: When COVID-19 affects muscle: effects of quarantine in older adults. Eur J Transl Myol. 2020, 30:9069. 10.4081/ejtm.2019.9069
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written by Narayana Health May 14, 2020

- Post-COVID Conditions can include a wide range of ongoing health problems; these conditions can last weeks, months, or years.

- Post-COVID Conditions are found more often in people who had severe COVID-19 illness, but anyone who has been infected with the virus that causes COVID-19 can experience Post-COVID Conditions.
- While most people with Post-COVID Conditions have evidence of infection or COVID-19 illness, in some cases, a person with Post-COVID Conditions may not have tested positive for the virus or known they were infected.
- People who experience Post-COVID Conditions most commonly report:
- **General symptoms (*Not a Comprehensive List)***

Tiredness or fatigue that interferes with daily life
Symptoms that get worse after physical or mental effort (also known as "post-exertional malaise")
Fever

- **Respiratory and heart symptoms**

Difficulty breathing or shortness of breath
Cough
Chest pain
Fast-beating or pounding heart (also known as heart palpitations)

- **Neurological symptoms**

Difficulty thinking or concentrating (sometimes referred to as "brain fog")
Headache
Sleep problems
Dizziness when you stand up (lightheadedness)
Pins-and-needles feelings
Change in smell or taste
Depression or anxiety

- **Digestive symptoms**

Diarrhea
Stomach pain

- **Other symptoms**

Joint or muscle pain
Rash

- https://www.who.int/news-room/questions-and-answers/item/coronavirus-disease-(covid-19)-post-covid-19-condition

Coronavirus disease (COVID-19): Post COVID-19 condition

- Vaccine and elderly.
- To ensure vaccination of senior citizens and differently abled population having limited mobility due to their physical condition, there is need to increase access by bringing vaccination services closer to the community and nearer to homes while maintaining all necessary precautions and safety measures.
- Near to Home COVID Vaccination Centres (NHCVC ... - MoHFW
- **COVID-19 vaccines**

- **Even with this history in mind, some reasonably wonder about the COVID-19 vaccines because they have not previously been approved for use in people. Now that millions of doses have been administered, we have learned about a few rare but severe side effects. They all occur shortly after vaccination till 6 months after the vaccine:**
- **Thrombosis with thrombocytopenia syndrome (TTS) —** TTS is a condition in which a person experiences blood clotting as well as low platelet count, called thrombocytopenia. The clots can occur in vessels in various organs or in the legs. TTS occurs in about 1-2 of every 1 million people who receive an adenovirus-based COVID-19 vaccine, like the J&J/Janssen vaccine.
- **Guillain-Barré syndrome (GBS) —** GBS is a condition in which the immune system attacks the peripheral nervous system, meaning the nerves that are not part of the brain or spinal cord, but which are located throughout the rest of the body. GBS has been found to occur in about 1 of every 100,000 people who receive an adenovirus-based vaccine (e.g., J&J/Janssen). It typically occurs during the first three weeks after getting vaccinated.
- **Myocarditis — Myocarditis is an inflammation of the heart.** About 1 of every 50,000 mRNA-vaccine recipients experience this condition.
- https://www.chop.edu/news/long-term-side-effects-covid-19-vaccine

Dr.Neville M Alberto – Note

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Pulmonary fibrosis is seen in almost 30 percent of patients who survived COVID pneumonia.
More common in older patients specially male.
Other predisposing risk factors include ARDS prolonged mechanical ventilation, comorbid conditions such as copd, hypertension and diabetes.
Post discharge striking abnormalities are seen in PFT with reduction in the diffusion capacity and hypoxia on ambulation.
Some patients recover with time and pulmonary rehab.
CT chest showed ground glass capacities and parenchymal bands.
Honeycombing was rare.
Over the time radiographic studies improved.
Omicron COVID rarely causes lung injury.
The term "Post-COVID Conditions" is an umbrella term for the wide range of physical and mental health consequences experienced by some patients that are present four or more weeks after SARS-CoV-2 infection, including by patients who had initial mild or asymptomatic acute infection.

They include:
Dyspnea or increased respiratory effort
Fatigue
Post-exertional malaise* and/or poor endurance
Cognitive impairment or "brain fog"
Cough
Chest pain
Headache
Palpitations and tachycardia
Arthralgia
Myalgia
Paresthesia
Abdominal pain
Diarrhea
Insomnia and other sleep difficulties
Fever

Lightheadedness
Impaired daily function and mobility
Pain
Rash (e.g., urticaria)
Mood changes
Anosmia or dysgeusia
Menstrual cycle irregularities
Erectile dysfunction
The information shared has been described in literature:
The working definition of Post-COVID Conditions was developed by the Department of Health and Human Services (HHS) in collaboration with CDC and other partners.

People call Post-COVID Conditions by many names, including: Long COVID, long-haul COVID, post-acute COVID-19, post-acute sequelae of SARS CoV-2 infection (PASC), long-term effects of COVID, and chronic COVID.

Dr.Luis Noronha – Note

Dr.Luis Noronha
Chief of Staff and Director of
ICU/Hospitalist Program at Desert Valley Hospital in California,USA.

Since I work primarily in the hospital as an intensivist, my main encounter with post COVID patients is in regards to the sequelae from COVID injury to their cardiopulmonary systems. The main ones being pulmonary fibrosis and cavitation, ongoing respiratory failure, secondary bacterial pneumonias, pulmonary thromboembolism and cardiac dysautonomia. The other complications of long COVID such as fatigue, neurocognitive issues, olfactory and gustatory symptoms, etc. are primarily evaluated and treated on an outpatient basis.

SARS COVID2 AND SARS COVID 19

Dr. Savio Rodrigues
Ex Prof and Head Dept of Microbiology GMC

SARS COVID 2 had been one of the deadliest viral pandemic in the current century infecting as many as 757 million people and causing 5.6 million deaths so far and is still active in many countries. The virus which was first reported as an outbreak in November 2019 in Hubei province in China Wuhan; went spreading far and wide resulting in full blown pandemic, alerting medical fraternity and challenging the capacity and standards of medical facilities all over, compelling WHO to declare a pandemic in Mach 2020. The virus was designated as the novel coronavirus 'SARS-CoV-2' by the International Committee on Taxonomy of Viruses and the WHO named the disease 'COVID-19'

Morphology and structure of the virus

SARS CoV 2 is a RNA virus belonging to the coronavirus family. It is an enveloped virus containing single stranded RNA, with helical symmetry and surface spikes (Peplomers) " S. " The beta subgroup of corona viruses, to which the SARS CoV 2 belongs has in addition to the peplomers (S) , a second type of surface projections, protein (N). The spike protein plays a vital role in binding of the virus to the ACE 2 receptors on the respiratory epithelium

The emergence of this virus is rooted in mystery, with some claiming that it is, possibly a manmade virus, but scientific evidence suggests that it is a zoonotic virus, transmitted probably from infected bats and Pangolins, through sale of later animal in open animal markets. It is also alleged that the transmission of infection might have occurred through sale of infected laboratory animals. The bat and pangolin viruses isolated only share 95-97% homology with human SARS Cov s, suggesting the existence of unknown source for the human virus. This virus has surpassed the predecessor Corona viruses, SARS and MERS in terms of number and severity of disease manifestations, pausing unprecedented global health problems

The virus genome is of interest as, the virus is prone for mutation giving rise to emergence of new variants that may or may not have enhanced pathogenic potentials with increased virulence or of increased transmissibility.

The genome also depicts the various antigenic variations that occur from time to time, coinciding with emergence of new mutants along with new clinical manifestation. Many countries have recorded and reported such variants as variants of interest (VOI) or variants of concern (VOC). The important variants reported so far includes alpha, bets, gamma, Delta, epsilon, Zeta, Eta, Theta, Iota, Kappa, Lambda, Mu, Omicron, XBB1.16. These variants can be detected by gene

sequencing of representative strains of all the strains routinely isolated, using sequencing technology which is now available in many institutions

Mode of transmission

The major mode of transmission of SARS CoV2 is by close contact with an infected person. The virus is expelled out through mouth and nose of infected person during coughing, sneezing, speaking, singing or breathing, in form of small liquid particles (aerosols). These particle may be inhaled by a person in the close vicinity or the infectious particle may from droplets that come in direct contact with eyes,, nose mouth or any other mucous membrane. The droplets may also settle on inanimate objects and form fomites, which may then be picked by hand touch and introduced in the eye, nose or mouth, stating the transmission cycle. In poorly ventilated areas the aerosols remain suspended in air for a relatively longer time and act as potential source of infection to susceptible people in that area. Further the aerosols may be carried away by air to a distant area and infect exposed subjects, in a similar manner causing wide spread infection.

Clinical manifestations

The virus is known to cause mild to severe respiratory infection which may lead to death, the severity differs based on the age group of the patient, virulence of the strain, premorbid condition and immune status of the patient. Many infected individuals, especially children and young adults, are asymptomatic, on the other hand older people and/or people with co-morbidities and immunosuppression are at higher risk of developing severe disease. The common presentations include anorexia, headache, fever, sore throat, cough, chest pain, breathlessness and haemoptysis. Various extra pulmonary manifestation such as olfactory and taste disorders, vomiting and abdominal pain are often reported along with pulmonary symptoms. These symptoms may be seen after an incubation period of 1-14 days, but is mostly confined to 4-5 days. In severe cases patient may develop respiratory failure, septic shock, marked lymphopenia and multiple organ dysfunction which is linked to production of cytokines. These cytokines may mount a severe cell mediated immune response referred to as cytokine storm which could result in fatal outcome. Secondary bacteria pneumonias is another known complication

Diagnosis

Early diagnosis and treatment is an important key for preventing wide spread transmission of covid 19. Diagnostic approach for covid 19 is based on a strategy that selectively identifies the SARS Covid 2 from other corona viruses. Molecular Tests that detects various genes of the virus is a method of choice and is considered as gold standard. Real time Polymerase chain (RTPCR) reaction based on amplification of viral RNA in the sample is designed to target various nucleic acid of the virus and is routinely used for diagnosis with high degree of specificity and sensitivity. The nucleic acid genes targeted include , ORF1b, RdRp, N, E, S genes and commercial RTPCR

assays are available for detection of each of these genes. A multiplex PCR is often used to cover more than one gene in a single assay run. The test assay is run after extraction of nucleic acid from standard samples with standard controls.

The E gene of corona viruses is shared by SARS CoV 2 and many other betacorona virus, hence presence of E gene positivity alone will not confirm Covid 19 infection. The PCR assay can be done after collecting a nasal swab, nasopharyngeal swab, oro-pharyngeal or swab from any other site, but the former is more sensitive and always preferred and collection of samples from two or more sites increases the positivity rate. The PCR result (values) expressed as CN/CT/Cq alues are inversely proportional to the virus load, in the sample, hence RTPCR measure the virus load in the sample, however, it does not reflect the virus load in the patient, as the sample collection technique cannot be standardized. These genes can be detected from day one of onset of fever and may remain detectable for several days, depending up on the severity of infection and the virus load in the patient. The test assay takes about two and half hours to three hours or more depending up on the type of kit used and the type of platform used to run the assay. A shorter version of molecular assay the "Turnet " test, involves a compact system for extraction and amplification and is widely used because of its simplicity and shorter time duration around of one and half hour. Every test done has to be recorded on the ICMR portal for statistical documentation

Apart from Molecular tests there are rapid antigen detection tests (RAT) available to detect viral antigen, using preferably a nasopharyngeal sample. These tests are not equally sensitive as RPCR test, their sensitivity being around 64%, and may be used as screening tests in symptomatic patients. More over these tests does not require laboratory equipment or set up and can be done by the patient himself or his relative. A positive rapid test would be useful for confirming the diagnosis, but a negative test does not rule out Covid 19 infection

Other supportive tests include, complete Haemogram, estimation of CRP, D-dimmers, Tumor necrosis factor alpha, Interferons and Interlukins profile etc. These markers have great prognostic value and in more severe cases associated with acute respiratory distress syndrome and cytokine storm. Radiological tests are also supportive in confirming the diagnoses and they reveal the extent of lung damage and fibrotic changes in the lungs. Serological tests has little role on diagnosis, but could be used as a marker of Covid 19 for surveillance studies.

Preventive measures

In a pandemic outbreak, preventive measures will not only decrease the morbidity and mortality but will also help to curtail and control the pandemic. As the primary mode of transmission is through generation of aerosols, social distancing from infected or suspected person and avoiding crowded areas is a key factor. Keeping a minimum distance of one meter would ensure you are not within the range of aerosols. Further using a N 95 mask would substantially reduce the risk of these aerosols entering your system. Frequent washing of hand would take care of transmission through fomites. Avoid putting fingers in the nose, mouth or eyes at all times, this will break the cycle of transmission. Since many infected persons may remain asymptomatic, such measures should be routinely taken considering any individual around you could be potentially infected especially during an outbreak or pandemic. Same standards should apply to you, as you could be yourself infected and moving around with a subclinical infection without your knowledge. Other

control measures include wide spread testing, contact tracing and testing as a pre-emptive measure, with subsequent identification and isolation of positive cases.

Vaccination for COVID 19

Vaccination is the most ideal preventive approach against any infection and promotion of an effective vaccine starts with designing of the vaccine followed by subsequent field trials. However, in COVID 19 vaccine had to be introduced as alternative emergency measures without standard vaccine trial protocols and evaluation of long term adverse effects. There are different approaches to vaccine, which include whole virus, protein subunit, viral vector and nucleic acid (RNA and DNA), each of these have different advantages and disadvantages and designed to provide immunity in different ways.

Ignoring all these drawbacks COVID 19 vaccines have reached billions of people worldwide and are claimed to be lifesaving in many cases, if not at least ensuring a milder outcome of disease in others. The long term side effects and safety of many vaccines are debatable, especially the concern over their safety in elderly subjects. The nasal vaccine which is yet to be popularized has an edge over other vaccines and is likely to replace all other vaccines in future.

The emergence of this new virus is a reminder and a clear warning that such viruses could be emerging from time to time, and we need to be fully prepared in terms of qualified man power and equipment and other supplies to handle such extensive outbreaks with confidence

Characteristics of SARS-CoV-2 and COVID-19

- Ben Hu,
- Hua Guo,
- Peng Zhou &
- Zheng-Li Shi

COVID-19 & HEMATOLOGICAL CHANGES

Dr Mahadeva Swamy
Haematologist
Bone marrow transplant Physician

Basic approach to any Haematological issues

- Main concept
    - Peripheral:- Blood cell changes
    - Central :- Bone marrow changes
- Peripheral
    - Red
    - White
    - Platelets

Haematological Manifestations of COVID

- *Immediate*
- *late onset*

Covid-19 & bone marrow changes

- Bone marrow suppression
    - Hypocellular marrow
    - Supressed Trilineage hematopoiesis : leading to pancytopenia
    - Bone marrow inflammation
    - Normocelllar marrow
    - Mildly reduced erythroid series
    - Mildly increased myeloid series
    - Increased megakaryocytes
    - Hemophagocytosis
- Bone marrow Aplasia (leading to Aplastic anaemia) very rare but possible.

Covid-19 & Thrombocytopenia

Three mechanisms of thrombocytopenia are hypothesized:

1. Direct infection of bone marrow cells by the virus and inhibition of platelet synthesis. Following virus infection, cytokine storm destroys bone marrow progenitor cells and leads to the decrease of platelet production. Lung injury indirectly results in reduction of platelet synthesis.
2. Platelet destruction by the immune system.
3. Platelet aggregation in the lungs, resulting in micro thrombi and platelet consumption.

Covid-19 & Anaemia

- Haemolytic anaemia
    - Coombs positive AIHA
    - Coombs negative
- Dysregulated iron metabolism

    - Anaemia related to inflammation
    - Anaemia related to underlying nutritional deficiency

Late-onset haematological complications post COVID-19

- Although it is well known that the disease primarily manifests as a respiratory tract infection
    - several studies have demonstrated that it should be considered a multisystemic disease including cardiovascular impairment, respiratory illness, gastrointestinal disorders, neurological symptoms, as well as hematopoietic and immune system dysregulation.
    - The multisystemic aspects of acute COVID-19 have been thoroughly evaluated; however, the long-term complications are still an underexplored area.
- "Long (haul)-COVID" is used to describe the ongoing effects of COVID-19 infection
    - post-intensive care syndrome
    - post-viral fatigue syndrome
    - Long-term COVID-19 syndrome.
- During COVID-19 pandemic, micro and macro vascular thrombotic complications have emerged as common clinical complications
    - Among critically ill and hospitalized patients.
    - Risk of pulmonary micro vascular thrombosis and arterial thrombotic events (infarction, stroke, limb ischemia) is also increased, albeit to a lesser extent than venous thrombosis (up to 17% in a recent meta-analysis).
- Multisystemic disease.
- COVID-19-induced coagulopathy, an immunothrombotic state, has been linked to thromboembolic and haemorrhagic events.
- Late-onset thrombocytopenia related to immune system dysregulation has also been reported as a rare manifestation post COVID-19.
- Close monitoring of laboratory dynamics is considered essential to identify timely abnormal values that need further investigation, providing supportive care whenever indicated.
- Would like to stress that patients who recover from COVID-19 need special attention and medical care in post-COVID clinics for the early identification of haematological and other late manifestations of SARSCoV-2.
- The role of haematologists is essential in terms of the multidisciplinary approach of long COVID-19.

COVID-19 & POST COVID-19 LUNG LESIONS

DR MANU.S
SENIOR RESIDENT, DEPARTMENT OF RESPIRATORY MEDICINE

- COVID-19 Disease is caused by Severe Acute Respiratory Syndrome Corona Virus 2
- (SARS-CoV-2)
- IP- **14 days** with median incubation period being 4 days
- Viral Pneumonia is the most frequent serious clinical manifestation of COVID 19 prominently featuring fever, cough, dyspnoea, hypoxemia and bilateral opacities on chest radiograph.
- Severe hypoxemic respiratory failure consistent with berlin definition of Acute Respiratory Distress Syndrome **(ARDS)** develops in a significant proportion of patients with COVID-19 pneumonia.
- Patient who require mechanical ventilation may have a high risk for mortality.

CLINICAL MANIFESTATIONS

- 40-45% are asymptomatic
- Most common symptoms are fever and dry cough

Constitutional Symptoms-

- Fever
- Myalgia
- Headache

Upper respiratory symptoms-

- Rhinorrhoea
- Sore throat

Lower respiratory symptoms-

- Cough
- Sputum
- Chest tightness
- Dyspnoea
- Haemoptysis

Other symptoms-

- Diarrhoea
- Nausea/Vomiting
- Loss of smell(Anosmia)
- Loss of taste(Ageusia)

ARDS

- New or worsening respiratory symptoms within **one** week of infection
- Chest x-ray revealing **bilateral opacities** not fully explained by effusions, lobar or lung collapse, or nodules

- **Respiratory failure** not fully explained by cardiac failure or fluid overload
- Mild ARDS-P/F ≤300-200mmhg with PEEP of ≥5cm h2O
- Moderate ARDS-P/F 200-100 with PEEP ≥5cm h20
- **Severe ARDS-P/F ≤100** with PEEP ≥5cmh2O

Critical Care Intervention

- Respiratory rate >30/min
- BP<90/60mmhg
- Spo2<85%
- P/F <250
- SOFA score > 2
- Altered mental status

Mortality Risk Factors

- Diabetes Mellitus
- Chronic Kidney Disease
- Decompensated Liver cirrhosis
- COPD
- Bronchial Asthma
- Interstitial Lung Disease
- Cerebrovascular Accident
- Coronary artery Disease
- Age>60 years
- Obesity
- Underlying Malignancy

Laboratory Investigations

- **RTPCR** (Reverse Transcriptase Polymerase Chain Reaction)- Uses PCR technology to amplify small amounts of RNA from specimens into deoxyribonucleic acid (DNA), which is replicated until SARS-CoV-2 is detectable if present.
- Specimen can be Nasopharyngeal, Oropharyngeal, BAL, Sputum, Blood
- **Rapid Antigen Test** - try to identify one of the outer proteins of the viral shell or envelope such as spike protein/ Nucleocapsid protein

Cytokine Storm

- Cytokine storm is a fast-developing, Life-threatening clinical condition in which there is overproduction of inflammatory cytokines and excessive activation of immune cells
- It leads to complicated medical syndromes such as persistent fever, hypotension, capillary leak syndrome, ARDS, Multiorgan failure, and death if not treated

Criteria for Cytokine Storm

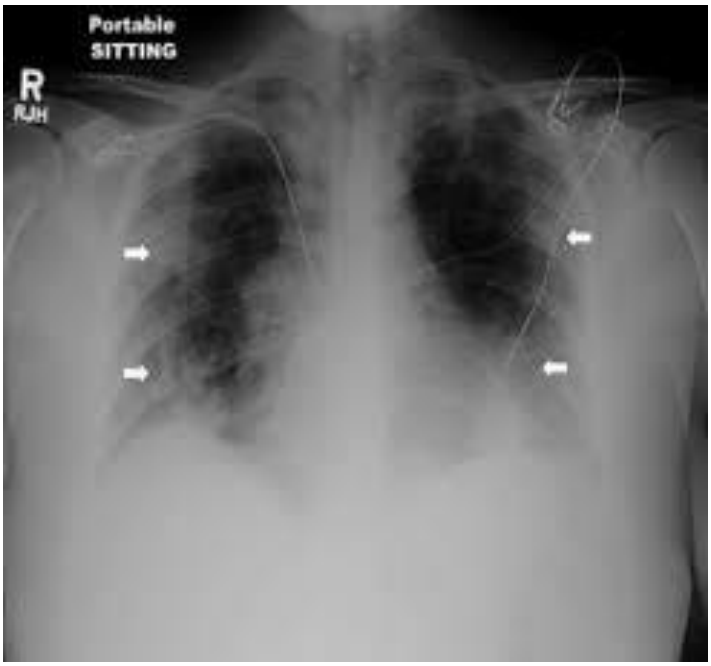
- **Persisting fever**(>38.3) more than 7days
- IL-6> 40pg/ml
- Ferritin > 1000ng/ml
- LDH>500IU/L

- D-dimer>1000ng/ml
- Desaturation despite use of steroids after 48hrs

Xray Patterns in Covid-19 Pneumonia

1. **REVERSE BATWING** APPEARANCE
2. LOWER LOBE CONSOLIDATION
3. PERIBRONCHIAL INVOLVEMENT
4. NOT FITTING 1,2,3
5. ROUND PNEUMONIA
6. ARDS

Reverse bat wing appearance



CT-Thorax (RSNA)

1-TYPICAL

Peripheral B/L ground glass opacity +/- consolidation or crazy paving
Multifocal dense ground glass opacity +/- consolidation / crazy paving
Reverse halo sign +/- consolidation / crazy paving

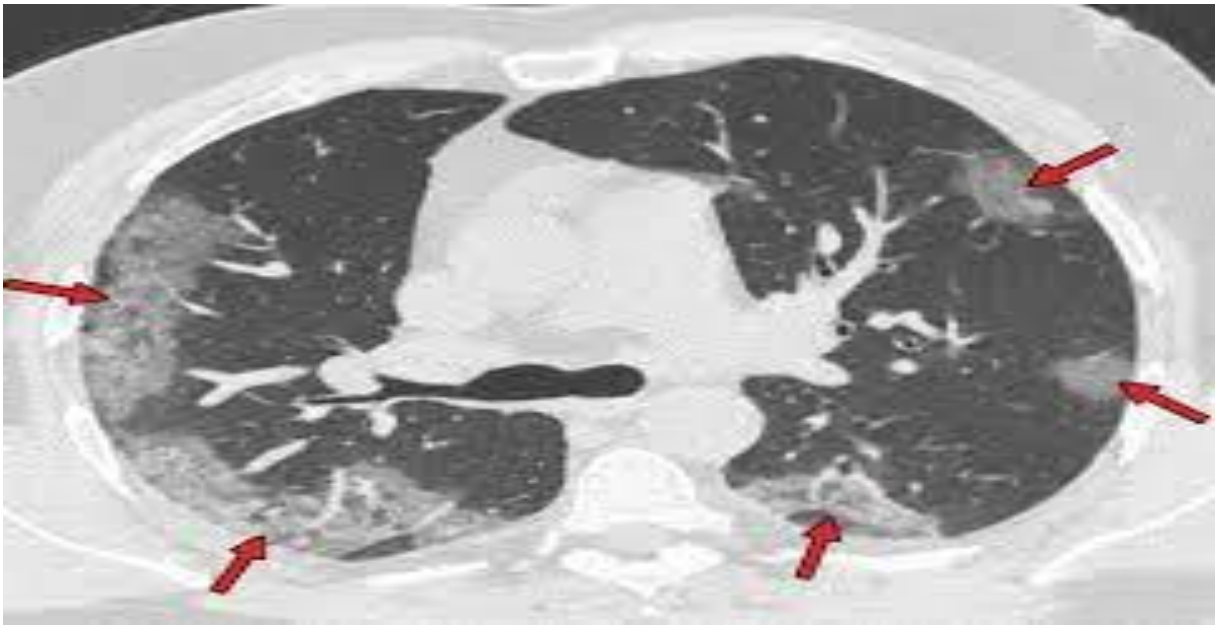
2-INDETERMINATE

Absence of typical findings with multifocal diffuse **perihilar**/upper lobe predominant +/- consolidation

3-ATYPICAL

Absence of typical/indeterminate findings with lobar/segmental consolidation/nodules/cavity/effusion/Septal thickening

4-NEGATIVE FOR PNEUMONIA



POST COVID SYNDROME

- Multisystem syndrome in which the symptoms persisting after **3wks** of diagnoses of Covid-19
- M/C symptoms are **Fatigue**, anxiety, mental health disease, chest pain, dyspnoea, olfactory/gustatory dysfunction, cough
- Lung involvement is in the form of-

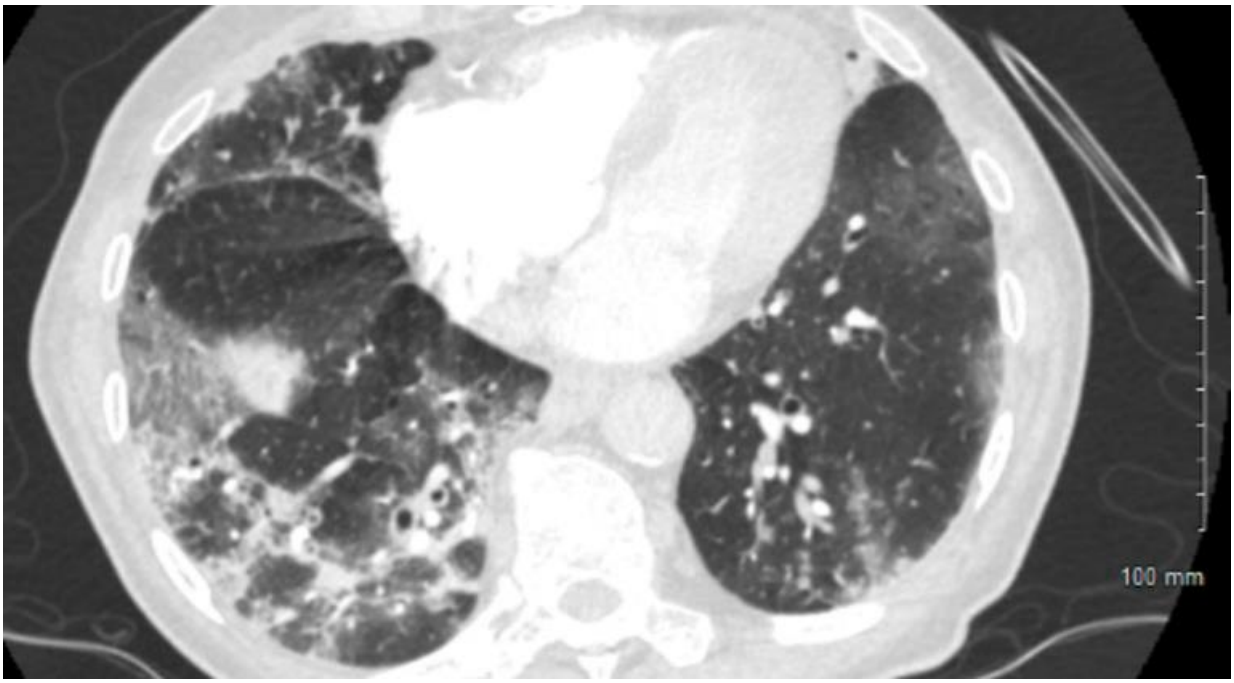
1) **Pulmonary Fibrosis**
2) **Pulmonary thromboembolism**
3) **Pulmonary Hypertension**

Risk Factors for Post Covid Fibrosis

- Prolonged ICU stay
- Mechanical Ventilation
- Age > 65
- Smoking history
- BMI > 30kg/m2
- Elevated biomarkers like LDH , Ferritin , CRP , D-dimer

Radiological Findings in post covid fibrosis

- Most common finding is persisting **ground glass opacities**
- Peripheral consolidations
- Tractional Bronchiectasis
- Fibrotic Bands
- Interlobular septal thickening
- Crazy paving


100 mm

ROLE OF HRCT THORAX IN COVID -19 AND POST COVID-19 LUNG LESIONS.

Dr. Prithviraj desai
Jr. Resident
Department of Radiology
Goa medical College

HRCT Chest in COVID-19

High resolution computed tomography is a non-invasive modality to study lung involvement in COVID-19 positive patients and to suggest possibility of COVID -19 in patients presenting with typical symptomatology of COVID-19.

The prevalence of chest CT abnormalities in COVID-19 infection depends on the stage and severity of the disease.

Typical findings in COVID -19

1) Ground glass opacity (GGO)

GGO is the most common finding in COVID-19.

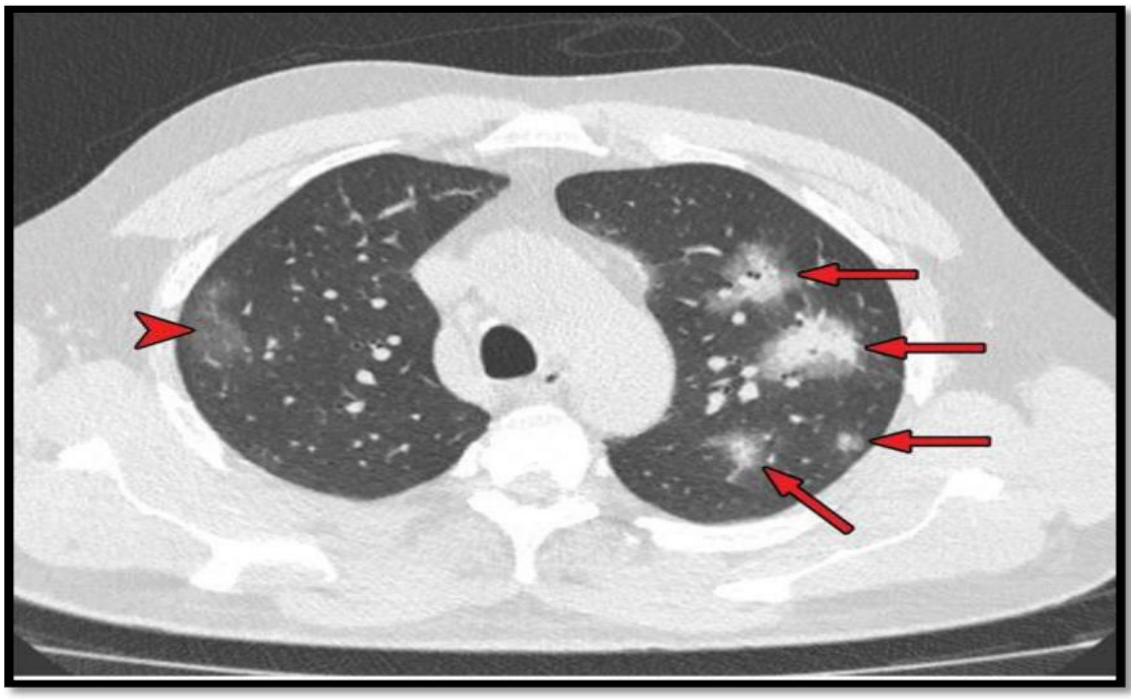
It is an area of increased attenuation in the lung on CT with preserved bronchial and vascular markings.

They are usually :

multifocal, bilateral and peripheral in location.

2) CRAZY PAVING

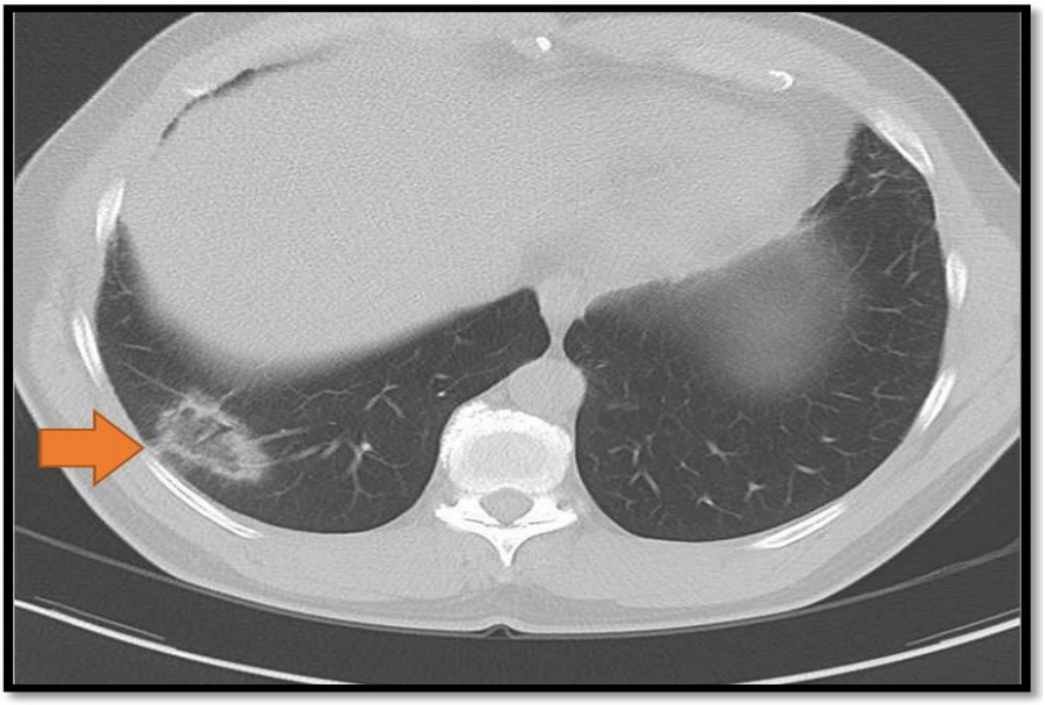
Occurs due to thickened interlobular and intralobular lines in combination with a ground glass pattern.



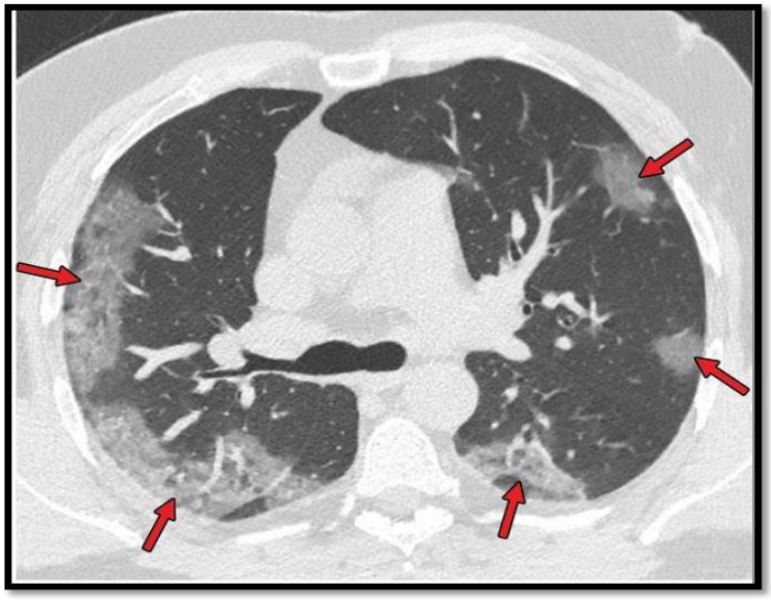
HALO SIGN (Arrows). GGO (Arrow head)

4) Reversed halo sign – Atoll sign

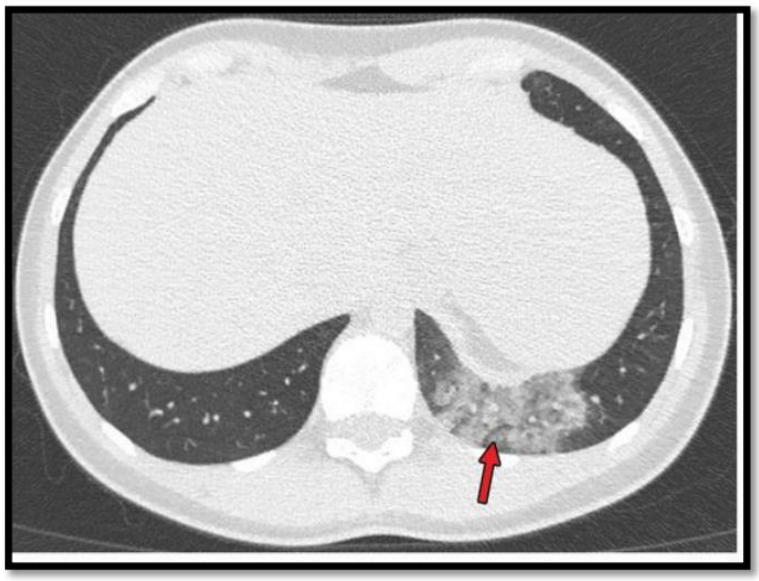
Area of ground glass density surrounded by consolidation.



Reversed halo sign – Atoll sign



Typical imaging features **of COVID-19 pneumonia according to the RSNA chest CT classification system. Axial non contrast chest CT image shows bilateral areas of GGO's (arrows) in a peripheral distribution.**



Indeterminate appearance of COVID-19 pneumonia. Axial non-contrast chest CT image shows an area of GGO (arrow) in the posterior basal segment of the LLL. No other lung abnormalities seen.

Temporal Evolution of Lung Abnormalities at Chest CT

Four stages of COVID-19 at chest CT have been described:

(a) Early stage (0–5 days after symptom onset). –

Characterized by either normal findings or mainly consist of ground- glass opacities.

(b) Progressive stage (5–8 days after symptom onset). –

Characterized by increase in number of ground glass opacities and presence of crazy-paving.

c) Peak stage (9–13 days after symptom onset). –

Characterized by progression to consolidation.

(d) Late stage (≥14 days after symptom onset). –

Characterized by a gradual decrease of ground-glass opacities and consolidation, while signs of fibrosis (including parenchymal bands, architectural distortion and traction bronchiectasis) start to appear.

CT SEVERITY SCORE

Both lungs are divided into five lobes and each lobe is assessed individually for CT severity scoring.

The abnormalities that are considered significant for the disease includes:

Ground-glass opacity, consolidation, reticulation, interlobular septal thickening, crazy-paving pattern, linear opacities, subpleural curvilinear line, nodule, bronchial wall thickening, lymph node enlargement, pleural effusion and pericardial effusion.

Each lobe is awarded a CT score from 0 to 5, depending on the percentage of the involved lobe: -

- Score 0 – 0% involvement
- Score 1 – less than 5% involvement
- Score 2 – 5% to 25% involvement
- Score 3 – 26% to 49% involvement
- Score 4 – 50% to 75% involvement
- Score 5 – greater than 75% involvement.

The overall CT score is the total sum of the points from each lobe and ranges from 0 to 25

CORADS Classification

Based on the CT chest findings, the level of suspicion of COVID-19 infection is graded from very low (CO-RADS 1) up to very high (CO-RADS 5).

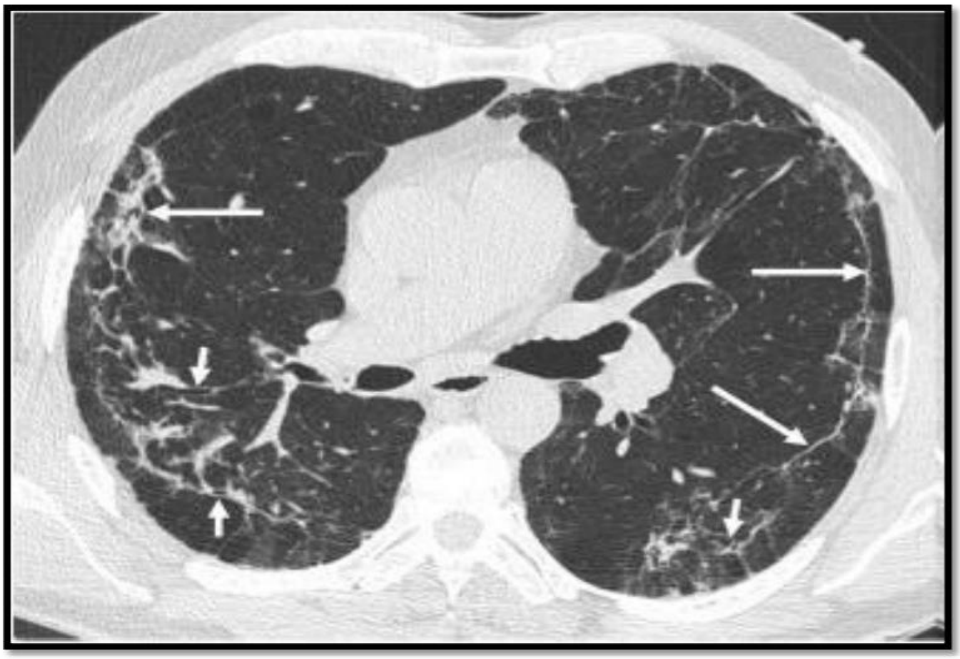
Sequelae of COVID-19 Lung Disease

Most of the patients who overcome the COVID-19 infection do not present with complications and do not require a follow-up.

- But a significant proportion (especially those with moderate/severe forms of the disease) require clinico-radiological follow-up.

Pulmonary fibrosis

This is a major respiratory complication after the acute phase of COVID- 19. The mechanisms by which this occurs are not clearly understood.
It seems to be more common after overcoming severe forms of the disease, especially in patients **who required ICU care, a longer hospital stay and had a greater inflammatory burden**.
CT features in post COVID-19 Lung Injury
Patients recovering from COVID-19 can have persistent symptoms and CT abnormalities which can be of variable severity.
The most frequently reported findings are:
GGO's and fibrotic like changes *(Most common)*.
Parenchymal bands.
Bronchiectasis.
Interlobular septal thickening
Reticular opacities
Consolidation
Fibrotic like changes include:
Architectural distortion with tractional bronchiectasis.
Honeycombing
Volume loss
Traction bronchiectasis/bronchiolectasis.
The fibrotic changes coincide with the areas where there was previously ground-glass opacity/other abnormalities during the acute episode of pneumonia.
This is to be expected, as they correspond to the areas of greatest involvement by lung inflammation.
As in acute COVID-19 pneumonia, fibrotic changes are most commonly bilateral and predominate in the peripheral region of the lower lobes.
The development of honeycombing is very rare.

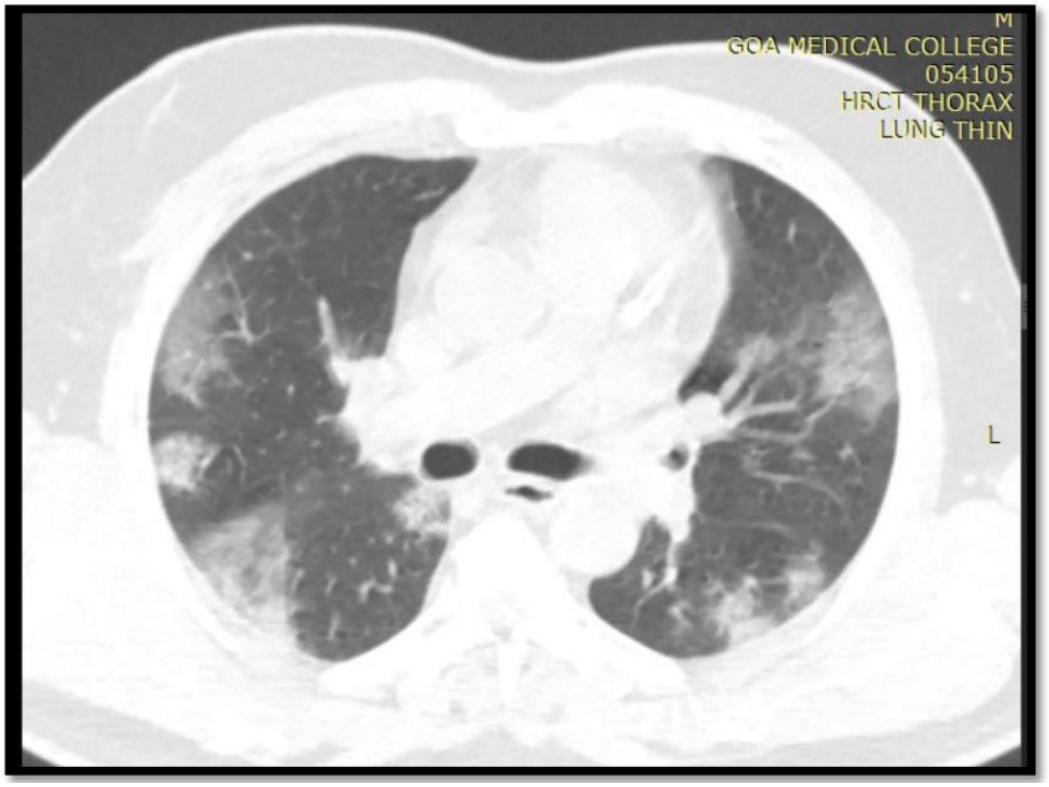


Subpleural parenchymal bands *("band opacities" and "subpleural lines", long arrows)* **with distortion of the lung architecture and bronchiectasis** *(short arrows).*

CASES

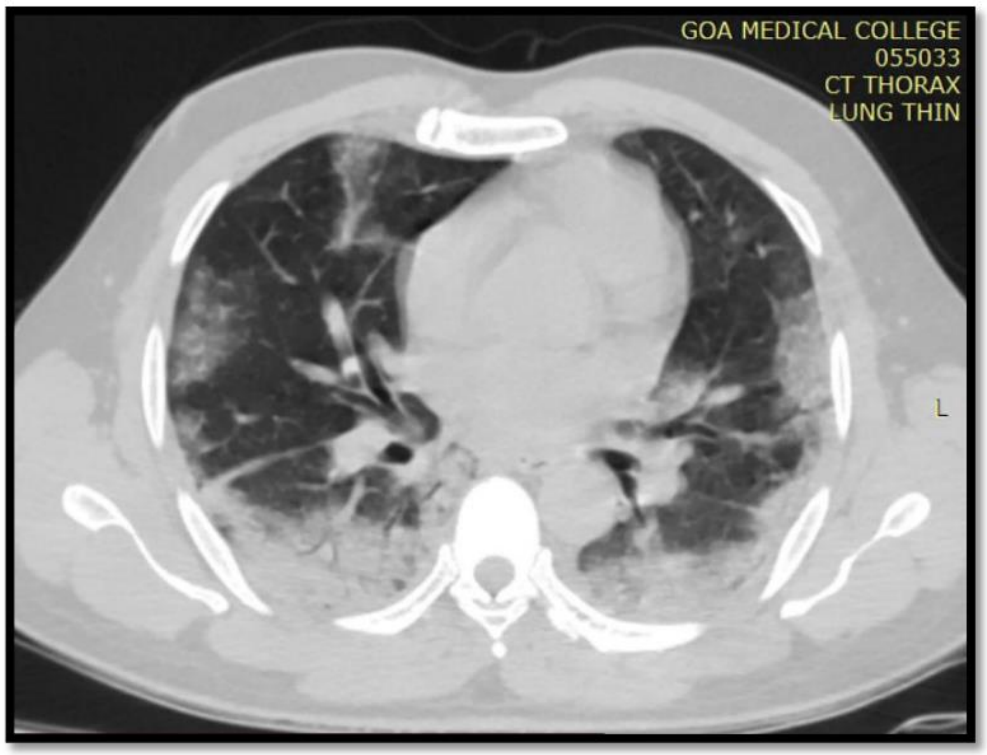
Case 1 : Ground glass opacity :

Multiple patchy areas of peripheral ground glass opacities in both lungs.



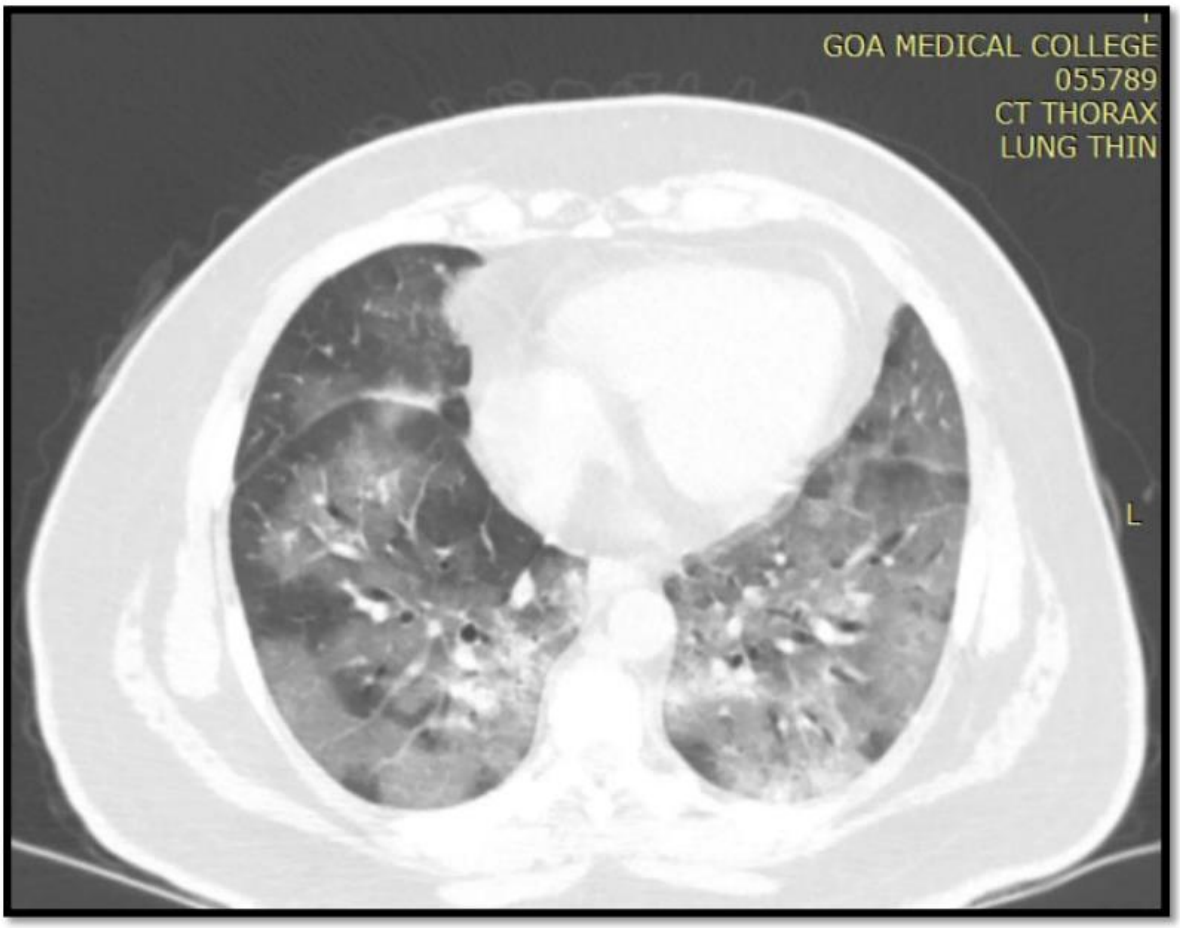
Case 2 : Consolidation

Areas of GGO's and consolidation in predominant peripheral location in bilateral lung parenchyma.



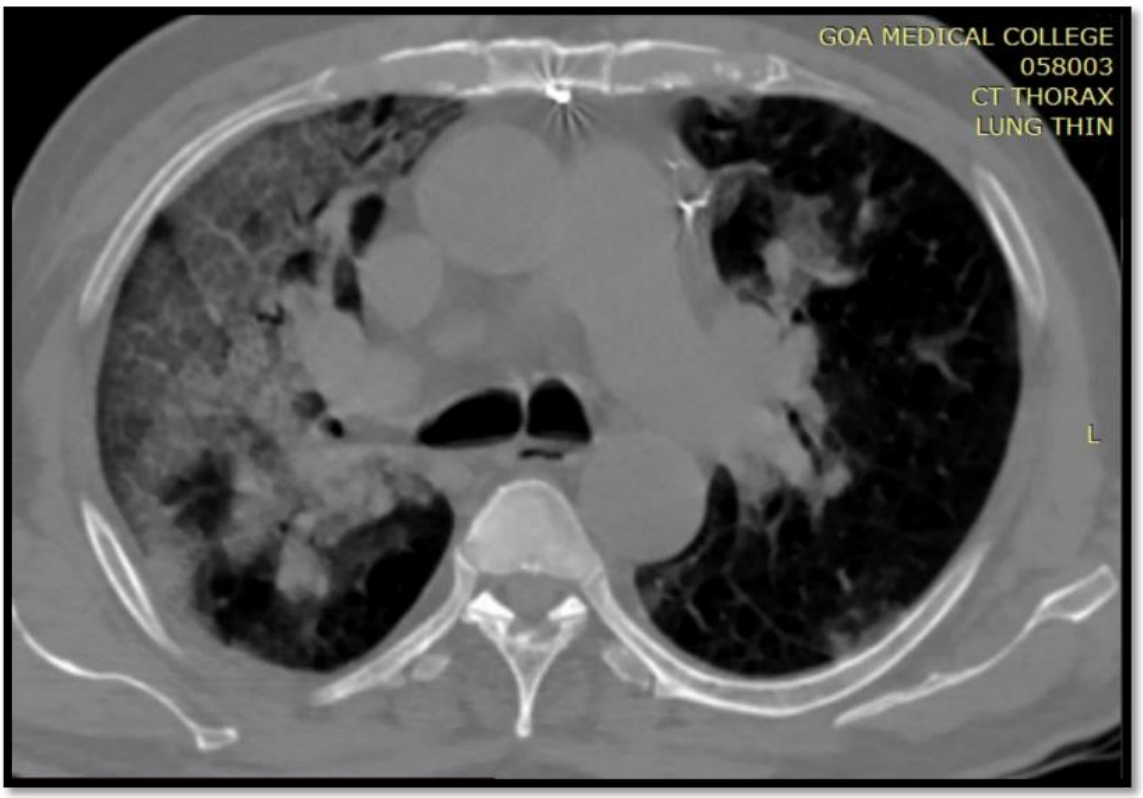
Case 3 : Diffuse GGO

Ground glass infiltration diffusely affecting both lungs giving the lung white out appearance.



Case 4 :Crazy paving

Right lung showing extensive ground glass with crazy paving appearance.



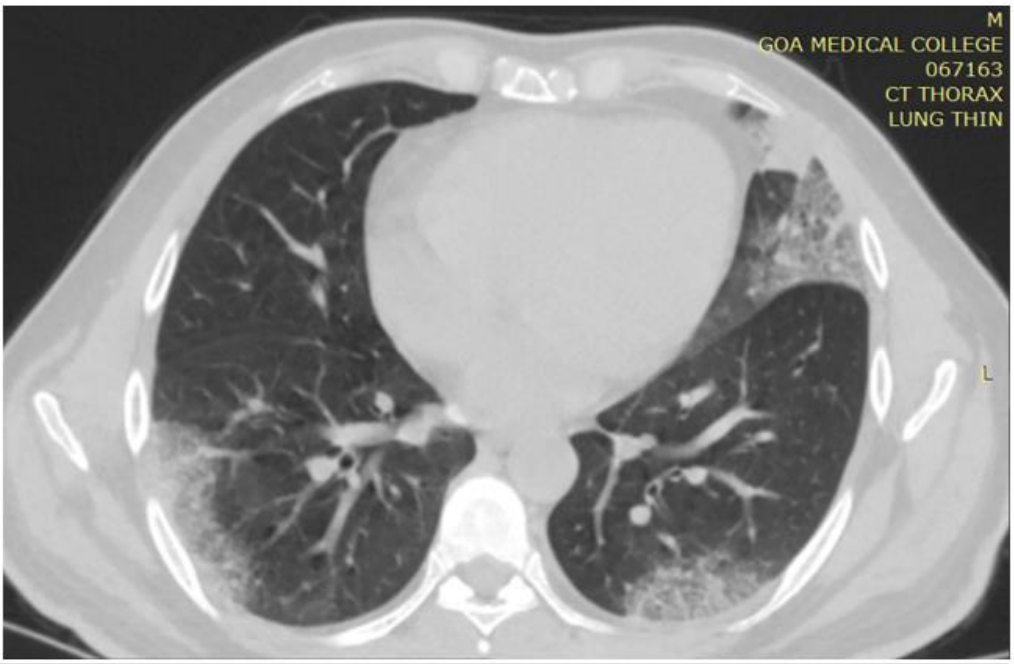
Case 5 : Halo Sign

Multiple peripheral areas of GGO. Halo sign is seen in the left lung.

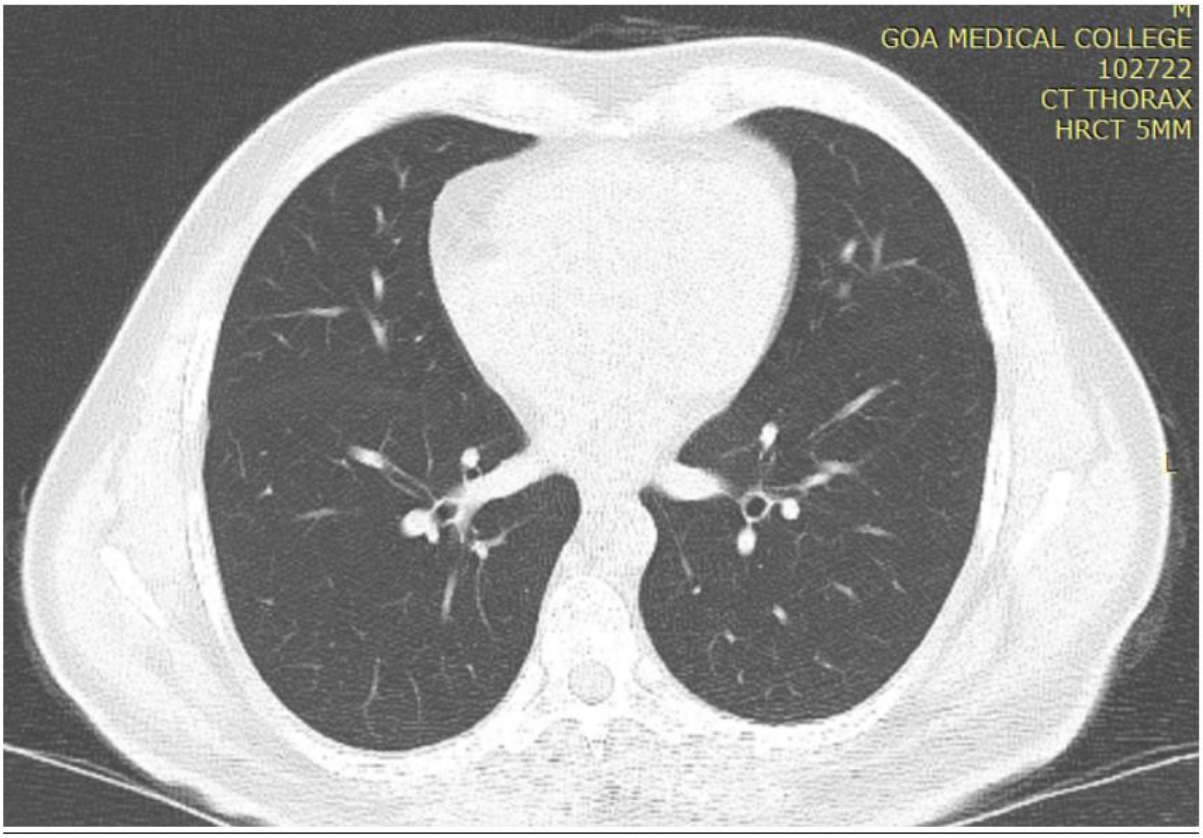
Case 6: Follow up HRCT thorax in COVID -19 pneumonia

Case of COVID-19 pneumonia (moderate CT severity score) with bilateral peripheral GGO and Crazy paving. Follow up CT scan after 6 months revealed complete resolution of the abnormalities.

a) Baseline scan

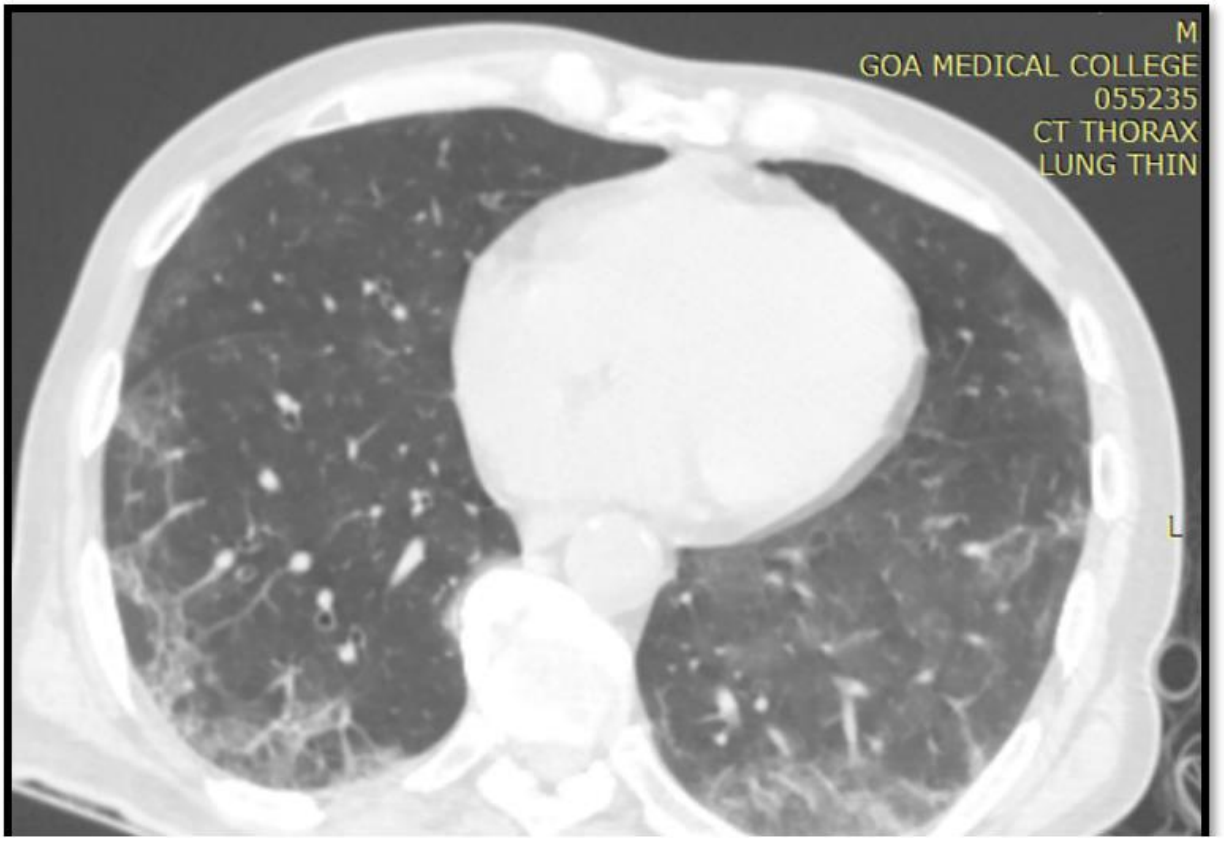


b) <u>Follow up scan</u>



Case 7 : Post COVID-19 Pulmonary sequelae.

Follow up scan performed after 6 months in patient with bilateral COVID pneumonia reveals bilateral pulmonary changes in the form of GGO, reticulations and linear bands.



MUCORMYCOSIS

Dr. Joyce Mendes
JR Pathology

Case summary

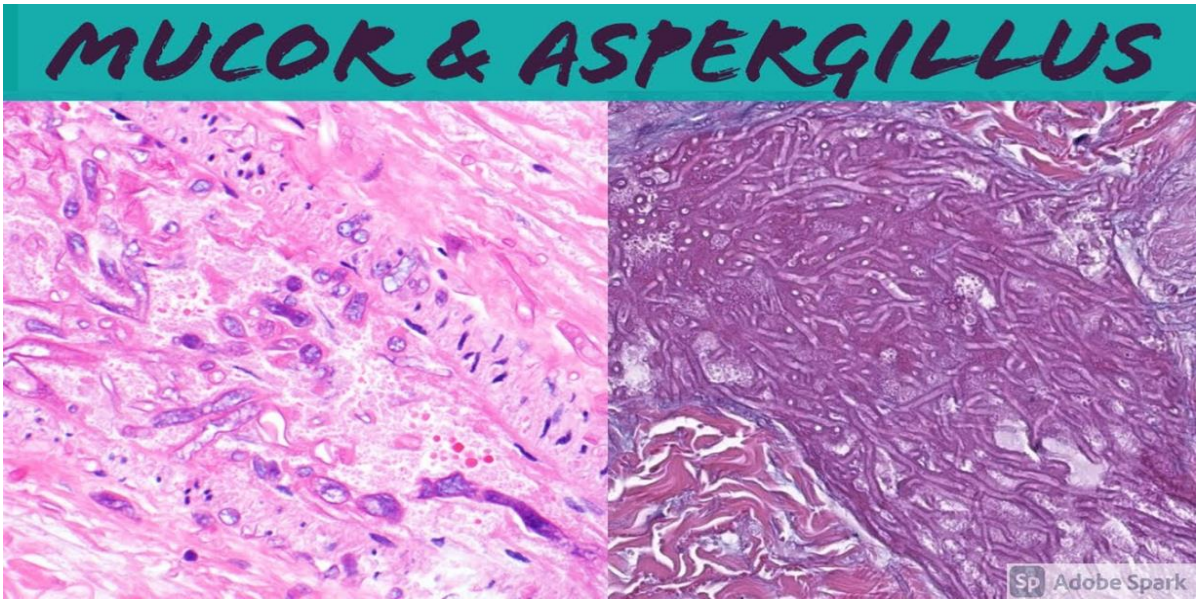
- 73 year old male
- k/c/o DM x 38 years
- Covid +ve
- Fever and cough x 14 days
- Nasal block x 2days and decreased sensation over ® cheek.
- Post op endoscopic debridement done
- Palatine bone with alveolar process, mucosa from the ® maxillary sinus and ® nasal mucosa.

Gross

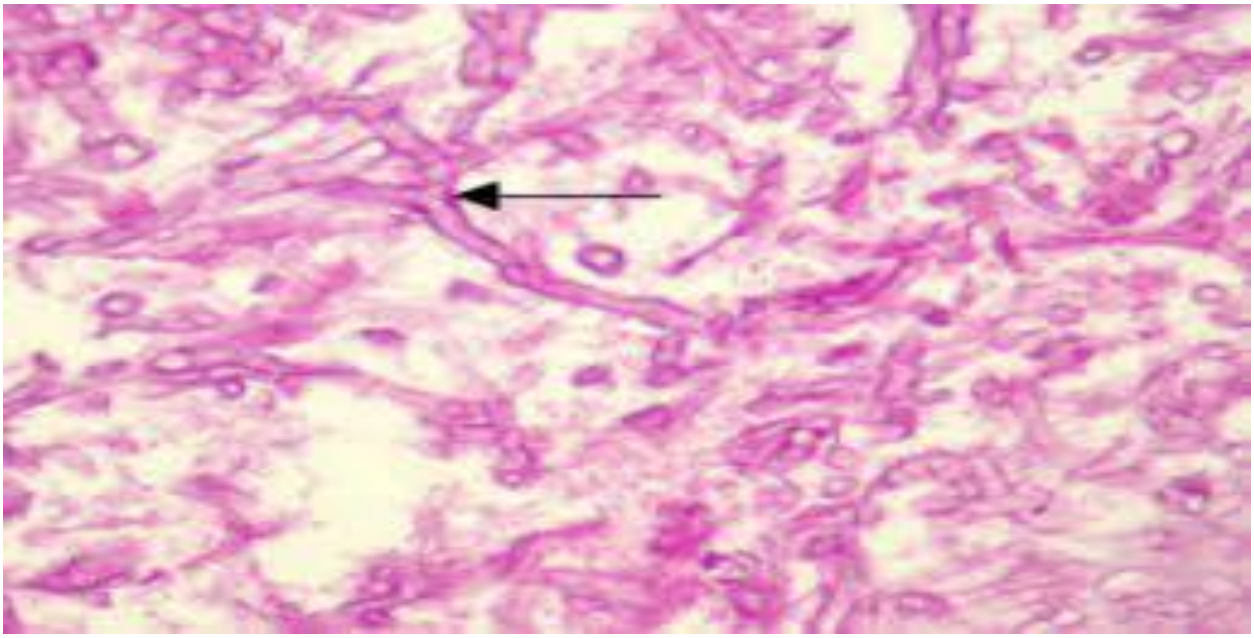
- Brownish white bits aggregating to 3cm.
- B/L maxillary sinus mucosa- Brownishwhite bits aggregating to 6cm with some bits showing blackish discoloration.
- B/L Nasal mucosa- Brownishwhite bits aggregating 1cm.

Microscopy

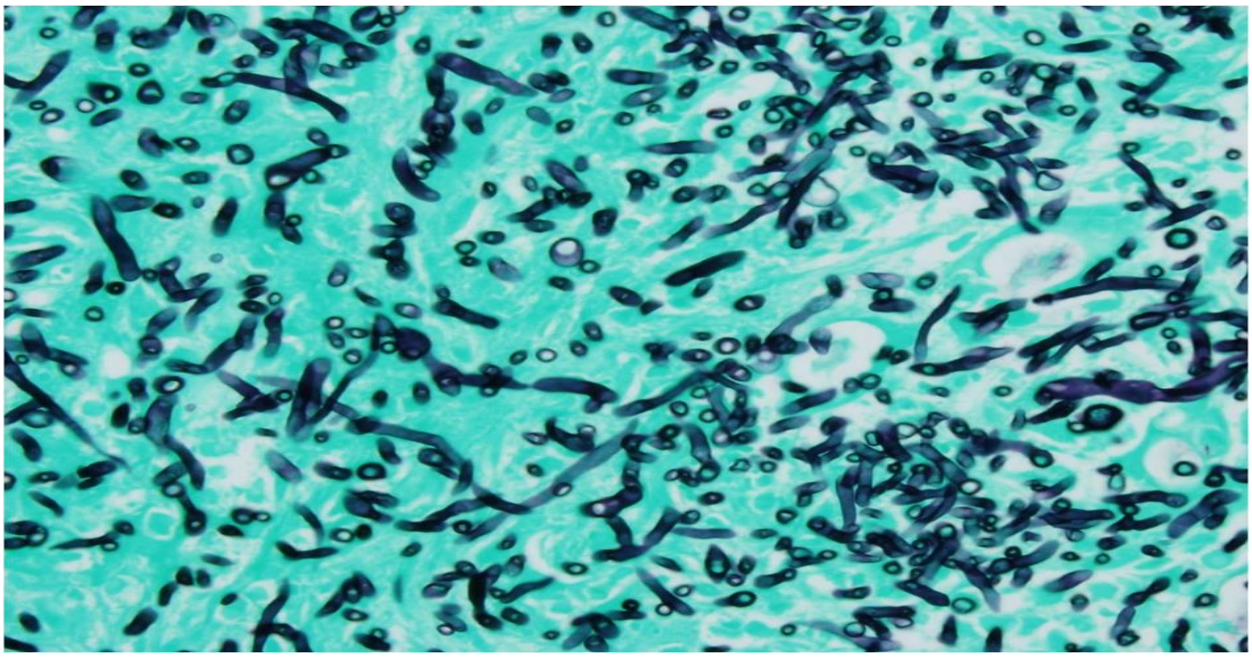
- Histopathological picture is consistent with mucormycosis with granulation tissue.



PAS STAIN



GMS STAIN



ANALYSIS OF COVID 19 AUTOPSIES

Dr. Cheryl Gonsalves
JR. Pathology

Coronavirus Disease (COVID 19)

- Coronavirus (COVID 19) is an infectious disease caused by the SARS-CoV-2 virus.
- Coronaviruses are enveloped, positive-sense, single-stranded RNA viruses.
- COVID 19 is characterized by respiratory symptoms, which deteriorate into respiratory failure in a substantial proportion of cases, requiring intensive care in upto a third of patients admitted to hospital.
- Analysis of the pathological features in the patients who have died with COVID 19 is of paramount significance for clarifying viral invading routes and distribution in the body, to benefit prevention and treatment.
- In this Comprehensive series we report the findings from 3 studies carried out during the COVID 19 Pandemic.
- Namely

1. Pulmonary post mortem findings in a series of COVID 19 cases from Northern Italy: A two Centre descriptive study
2. Autopsy of COVID 19 patients in China
3. Pathophysiology of SARS-CoV-2: the Mount Sinai COVID-19 Autopsy Experience

And summarize the key histopathological findings.

Pulmonary post mortem findings in a series of COVID 19 cases from Northern Italy: A two Centre descriptive study

The Lancet
Infectious Diseases
Volume 20, Issue 10, P 1135-1140, October 2020

Patient samples

- The following study was carried out in 2 referral centres for the management of the COVID 19 outbreak in Northern Italy: Luigi Sacco Hospital in Milan (20 autopsies) and Papa Giovanni XXIII Hospital in Bergamo (18 autopsies) in the time period from February 29th to March 24th 2020.
- All patients had SARS-CoV-2 infection confirmed by real-time PCR analysis of throat swab samples taken at the time of hospital admission, and all had undergone Molecular tests for common respiratory viruses and bacteria by the Microbiology laboratories at the respective hospitals, with negative results.

Autopsies and Tissue Processing

- Autopsies were done in airborne infection isolation autopsy rooms, with personnel using personal protective equipment in accordance with the Italian recommendations.
- A team of pathologists with extensive experience in the field of infectious diseases were involved in the autopsy procedures in both hospitals.

Results

- Patients were 33 men and 5 women with a mean age of 69years.
- Time spent in ICU or intermediate medical ward ranged from 1 to 23 days.
- Regarding past co morbidities, data were available for 31 patients.
- Nine(29%) had Diabetes
- Eighteen(58%) had Hypertension
- Four(13%) had past malignancies
- Eleven (35%) had cardiovascular disorders
- Three (10%) had COPD
- At the time of hospitalization, all patients had clinical and radiological features of interstitial pneumonia.
- Of the 26 patients with available D-dimer results, all had high values (>10times the upper reference limit).
- Mean time from symptom onset to death was 16 days.

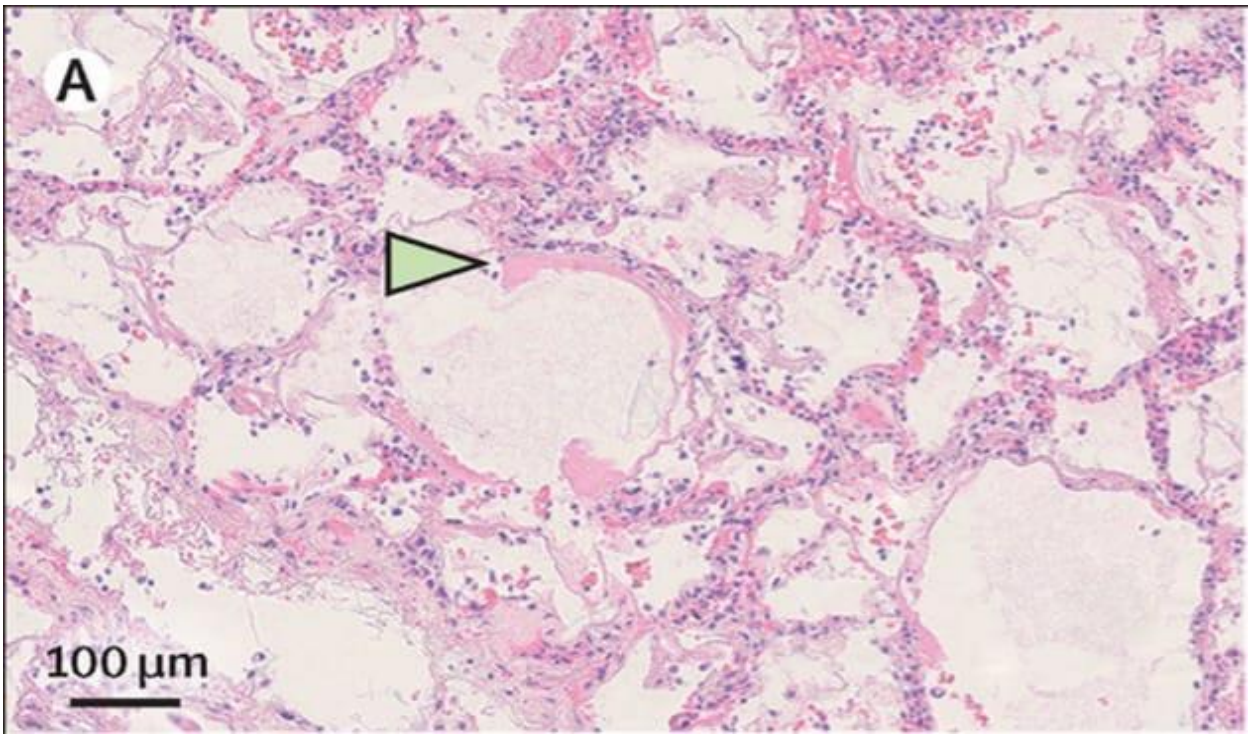
Histopathological Findings

- **Macroscopic Examination**
- The lungs of all patients were heavy, congested and oedematous, with patchy involvement.

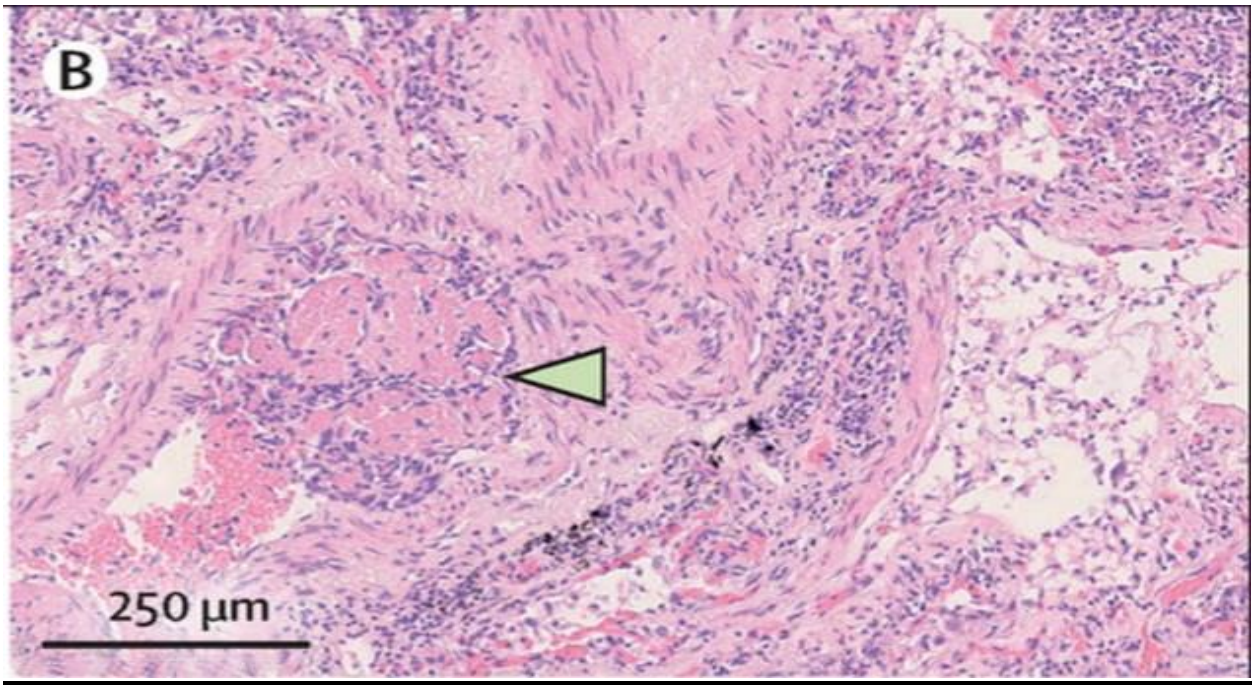
Microscopic Examination

- All cases showed features of the exudative and proliferative phases of diffuse alveolar damage, which included
- Capillary congestion (in all cases)
- Necrosis of pneumocytes (in all cases)
- Hyaline membranes (in 33 cases)
- Interstitial and Intra-alveolar edema (in 37 cases)
- Type 2 pneumocyte hyperplasia (in all cases)
- Squamous metaplasia with atypia (in 21 cases)
- Platelet-fibrin thrombi (in 33 cases)

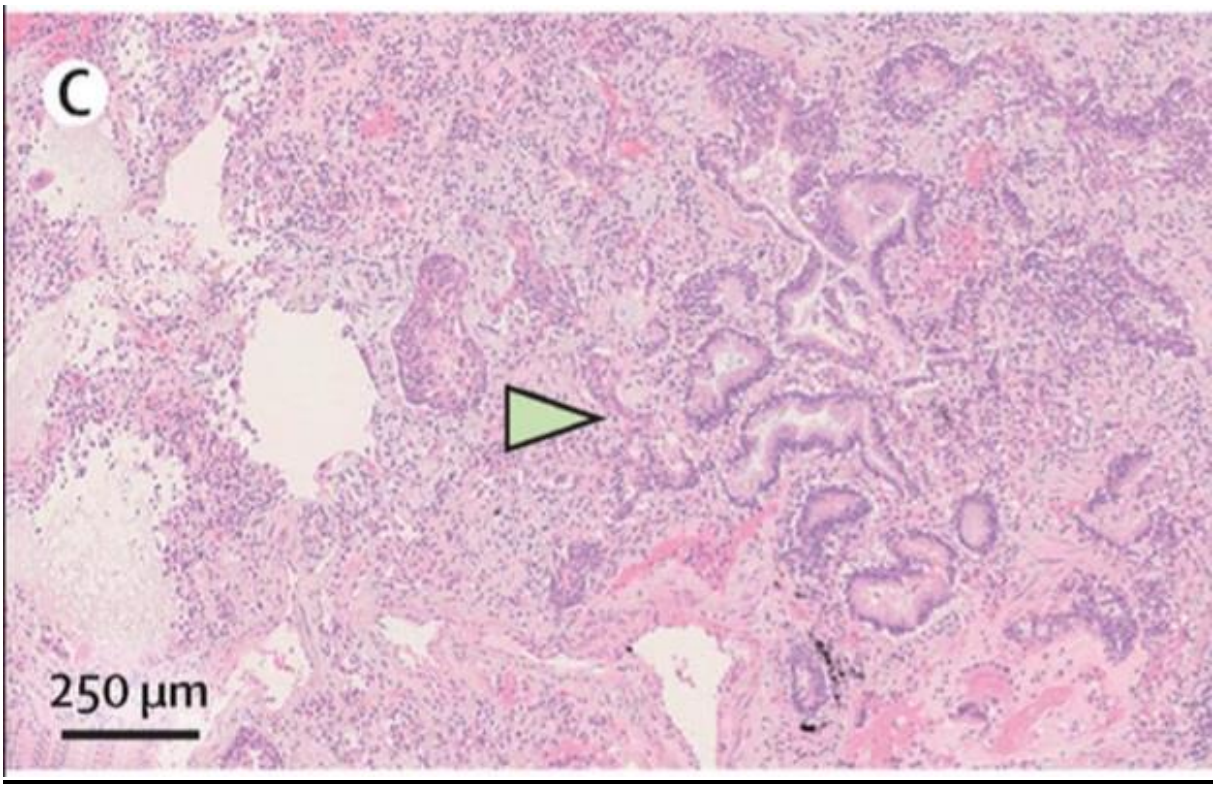
Exudative phase of diffuse alveolar damage with hyaline membranes (arrow)



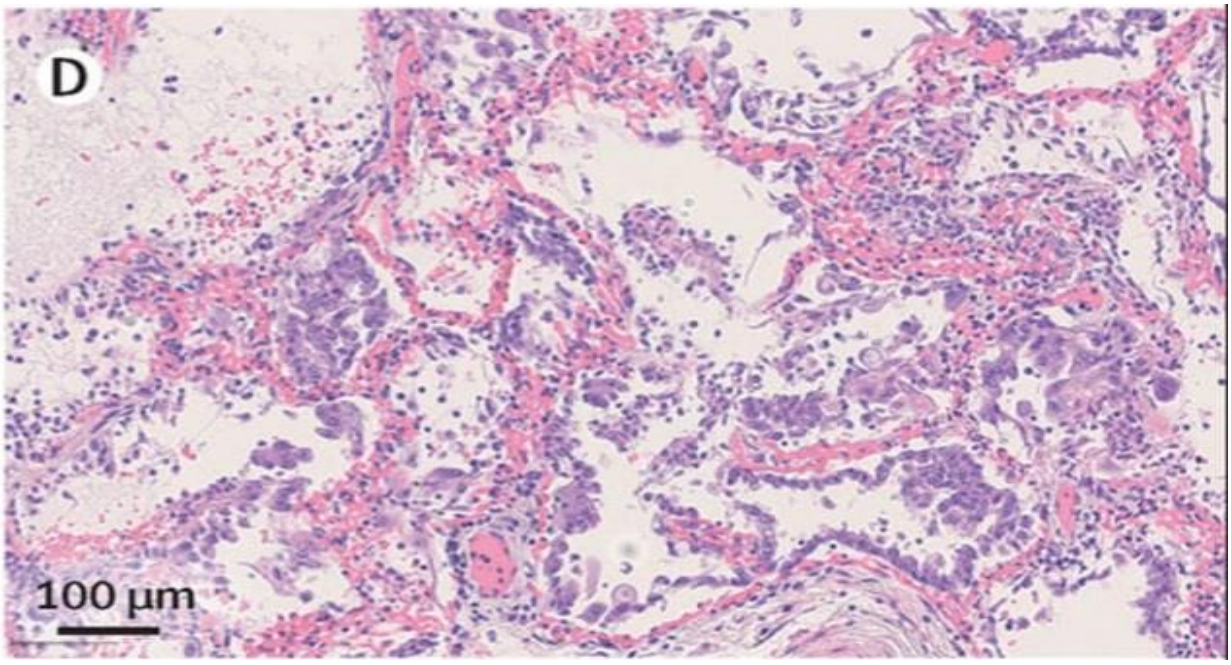
Organizing microthrombus (arrow)



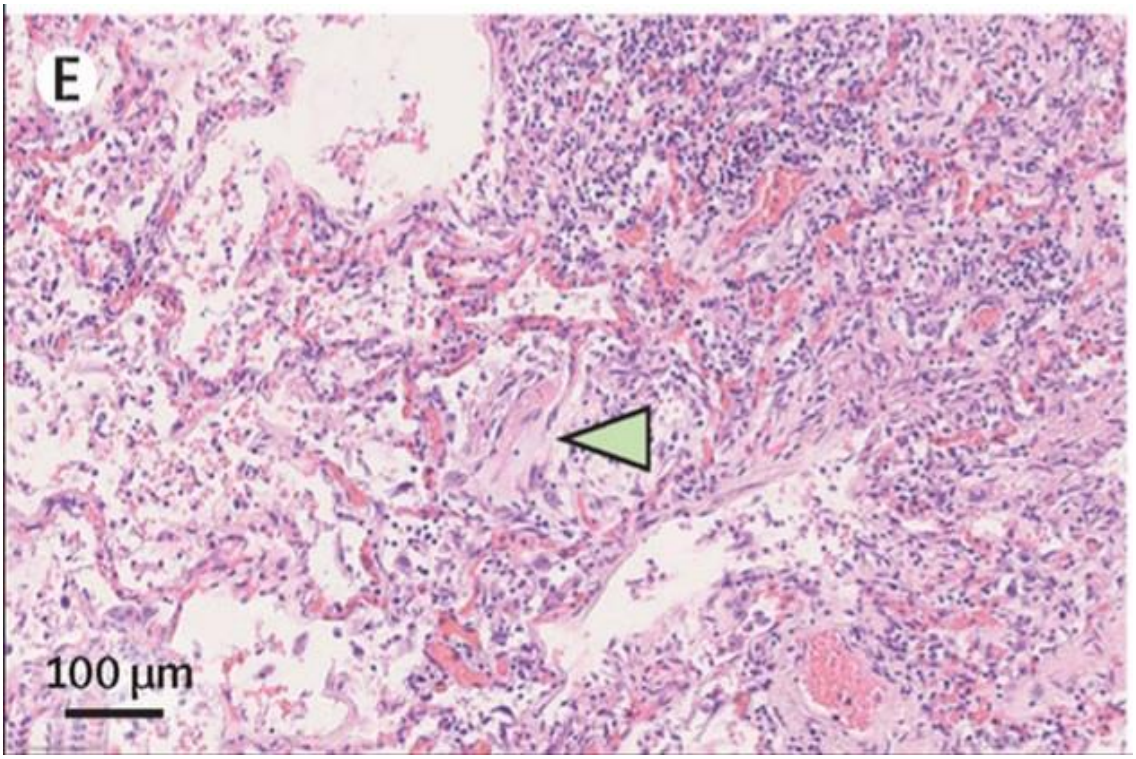
Concomitant interstitial pneumonia, intra-alveolar scattered multinucleated giant cells(top left) and outstanding epithelial proliferation around a bronchiole with plurifocal squamous differentiation and mild atypia (arrow)



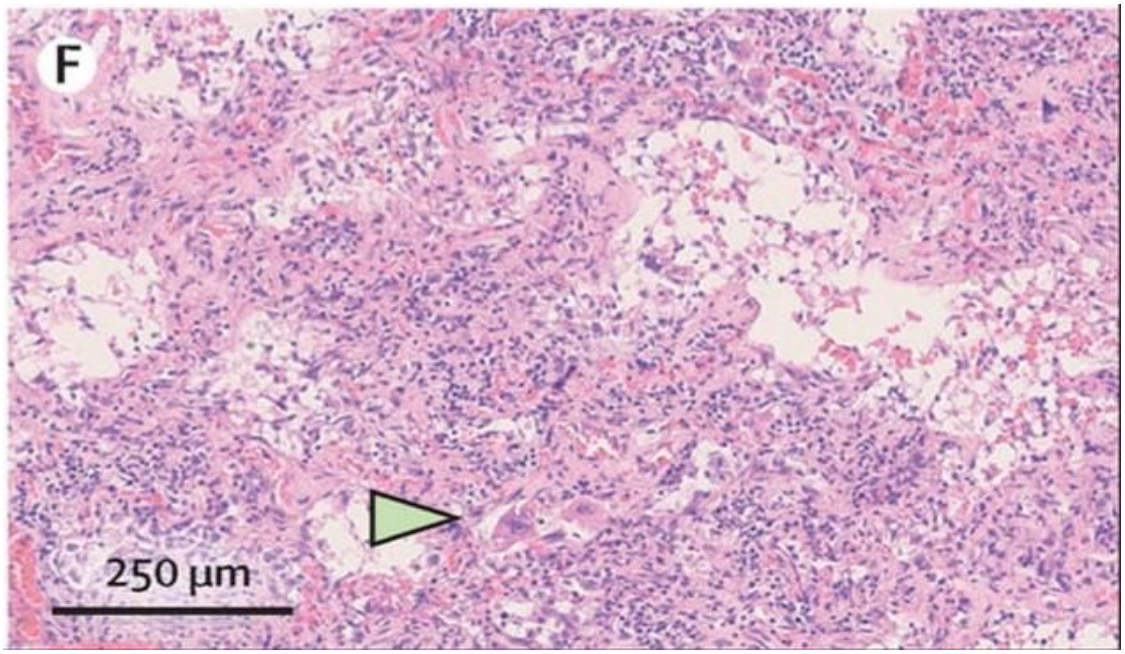
Early proliferative phase of diffuse alveolar damage with many hyperplastic, and rarely atypical, type 2 pneumocytes



Intermediate phase of diffuse alveolar damage with initial organizing aspects (arrow) and interstitial pneumonia with marked lymphocytic infiltrate

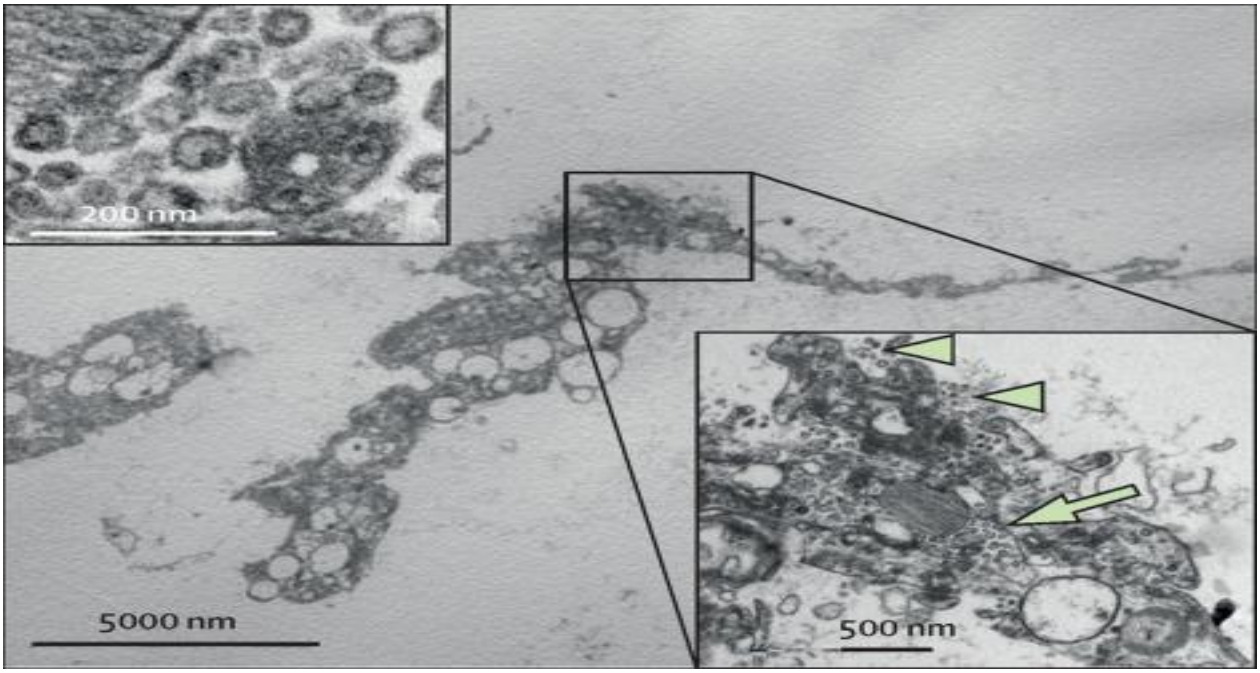


Advanced proliferative phase of diffuse alveolar damage with interstitial myofibroblastic reaction, diffuse lymphocytic interstitial infiltrate, and residual scattered hyperplastic type 2 pneumocytes(arrow)



- The inflammatory infiltrate, observed in all cases was largely composed of CD68 positive macrophage in the alveolar lumina (in 24 cases) and CD45 positive and CD3 positive lymphocytes in the interstitium (in 31 cases).
- Immunohistochemistry with anti- CD61 antibodies identified an increased number of megakaryocytes in the lung capillaries in 33 (87%) cases.
- Four (11%) patients also had bacterial abscesses (one or two per lung, <5mm in diameter) and one (3%) had a single fungal abscesses (<7mm in diameter). The abscesses were presumed to have formed after hospital admission.

Electron microscopy revealed that viral particles were predominantly located in the pneumocytes.



- Flat type 2 pneumocyte without lamellar electron-dense bodies of surfactant free in the alveolar space, containing numerous virions (inset bottom right) in cytoplasmic vacuoles (arrow) and along the plasma membrane (arrow heads).

Interpretation

- The predominant pattern of lung lesions in patients with COVID 19 patients is diffuse alveolar damage, as described in patients infected with severe acute respiratory syndrome and Middle East respiratory syndrome coronaviruses.
- Hyaline membrane formation and pneumocyte atypical hyperplasia are frequent.
- Importantly, the presence of platelet-fibrin thrombi in small arterial vessels is consistent with coagulopathy, which appears to be common in patients with COVID 19 and should be one of the main targets of therapy.

Autopsy of COVID 19 patients in China

National Science Review, Volume 7, Issue 9, September 2020, Pages 1414-1418

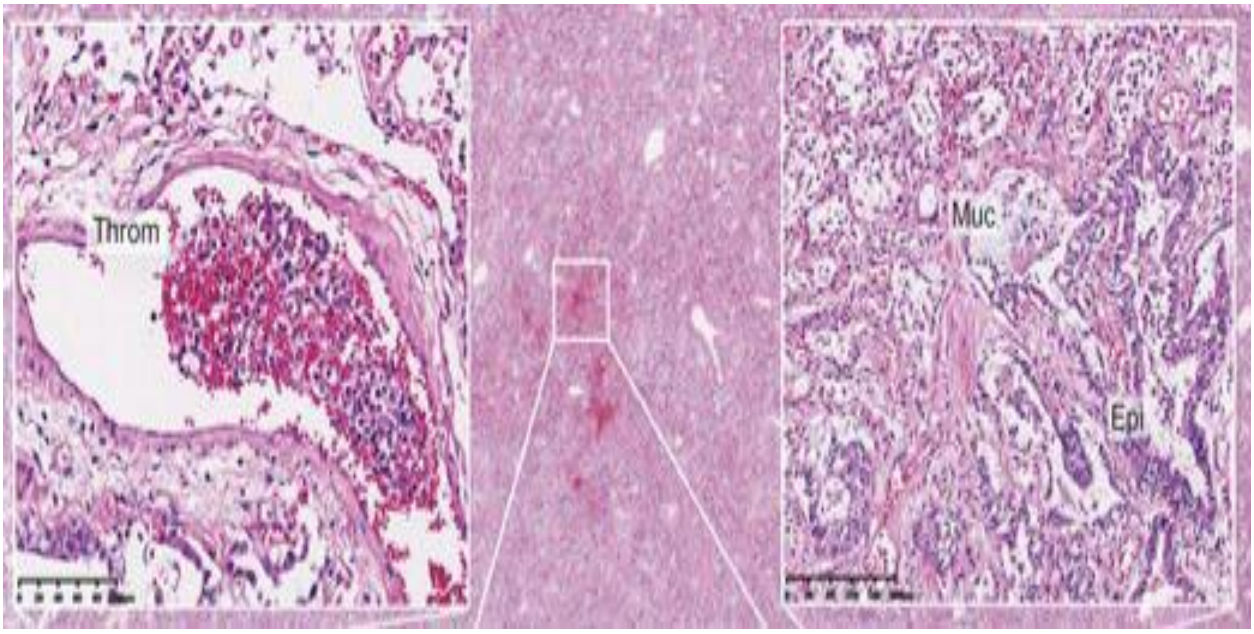
Autopsies

- Upon the outbreak of COVID 19, a Pathology Team was assembled in Wuhan and Chongqing, China.
- This team performed around 37 systematic autopsies on COVID 19 cases.
- In addition, percutaneous multiple organ Biopsy (minimally invasive autopsy) was carried out in 54 cases.

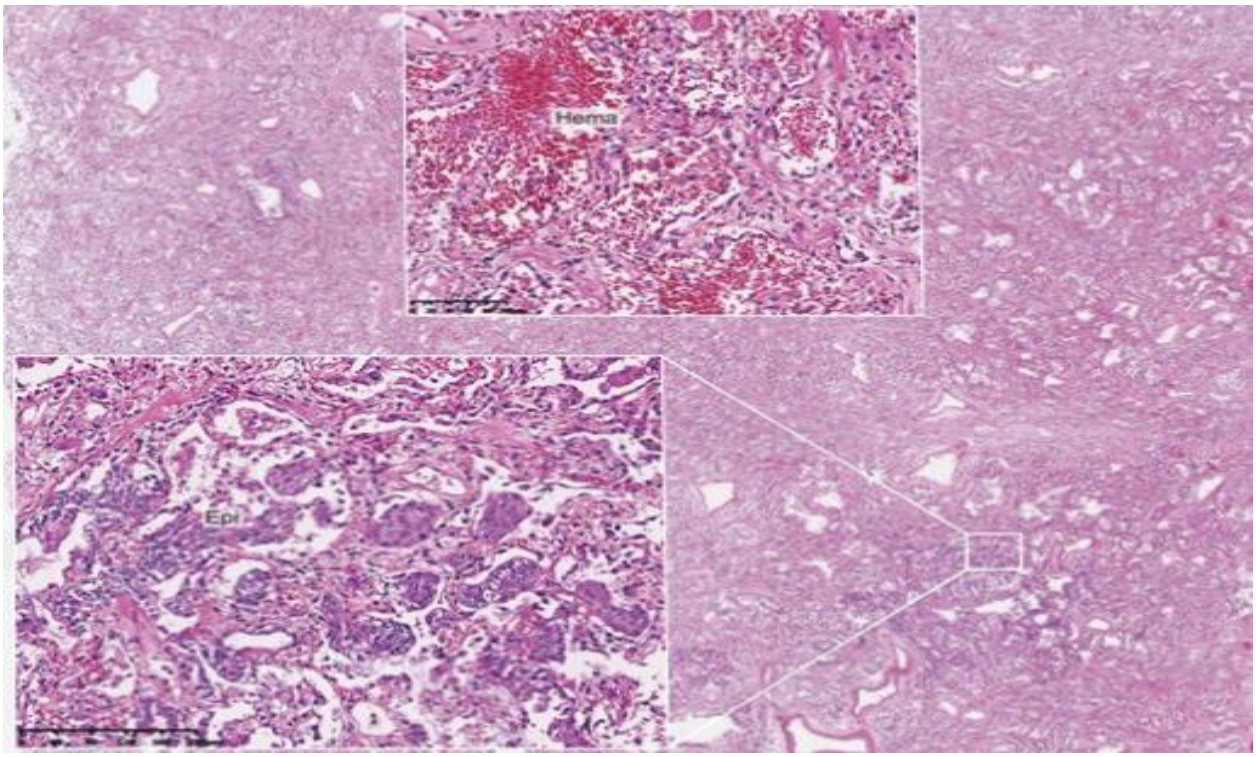
Major findings from the autopsy

- SARS-CoV-2 infection causes injuries in multiple organs and tissues with prominent and extensive pulmonary lesions.
- Pathological changes in the respiratory system were most significant.
- **Trachea and bronchus**
- Mucosa congestion
- Increased secretion
- Focal epithelial exfoliation
- **Light microscopy**
- Diffuse alveolar damage
- Exudative inflammation
- Serous and fibrin exudate filled alveolar spaces
- Hyaline membrane formation
- Focal pulmonary hemorrhage
- Hemorrhagic infarction/ Necrosis
- Pulmonary vessels- vasculitis, thrombosis and thromboembolism
- Exudate organization and Pulmonary Interstitial fibrosis in long disease duration.
- **Electron microscopy**
- Coronavirus particles were observed in the cytoplasm of tracheal and bronchial Mucosa epithelia and alveolar type 2 pneumocytes.
- Functionally, alveolar damage, exudation, interstitial inflammation and extensive thrombosis constituted a cause for ventillatory disorder.
- Airway epithelial hyperplasia, exfoliation and mucus congestion increased ventilation obstruction, especially in the small airway.
- Altogether, these changes were considered as a pathological basis for lethal respiratory failure.

Thrombosis, Mucus plugs, Epithelial proliferation



Hemorrhage, Epithelial Proliferation



Lymphatic Hematopoietic Organs

- Lymphocytes, especially CD4 and CD8 T-cells, were significantly reduced in the spleen and lymph nodes.
- Lymphocyte degeneration, necrosis and macrophage proliferation were observed.
- Hemorrhage and anemic infarction were often found in the spleen.
- Bone marrow in most cases contained reduced erythroid cells, myeloid cells and megalaryocytes, whereas a few cases also showed apparent hyperplasia.

Heart

- Myocardia displayed
- cell degeneration
- scattered necrosis
- interstitial edema
- mild infiltration of monocytes, lymphocytes and/or neutrophils.

Liver and gall bladder

- Hepatocyte degeneration
- Spotty necrosis
- Piecemeal, bridging or massive necrosis with neutrophil infiltration.
- Liver sinusoidal congestion
- Infiltration of lymphocytes and monocytes in portal areas
- Gall bladders were highly filled and Mucosa epithelia were exfoliated

Kidneys

- Hyperemia, segmental hyperplasia or necrosis in glomeruli and protein exudate in glomerular capsule chambers.
- Proximal tubules- epithelial degeneration, focal necrosis and exfoliation.
- Distal tubules- hyaline casts
- Renal interstitial tissues- congestion, mild inflammatory cell infiltration and fibrous hyperplasia.

Adrenal Gland

- Cortex degeneration
- Focal hemorrhage
- Necrosis

Pancreas

- Islet cell degeneration
- **Esophagus, Stomach and Intestine**
- Mucosa epithelia manifested different extents of degeneration, necrosis and exfoliation.
- **Testes**
- Various degrees of spermatogenic cell reduction and injury.

- **Brain**
- Hyperemia and edema
- Partial neuron degeneration
- Ischemic changes
- Neuronophagia, inflammatory cell infiltration in perivascular regions and focal cerebral infarction and brain herniation were seen in some cases.
- It was noted that the cadavers, especially the elders had primary health conditions.
- These existing conditions combined with the acute damage caused by SARS-CoV-2 constituted the pathological basis for multiple organ dysfunction syndrome, with more serious consequences from lesions in the lungs, heart, kidneys and liver.

Clinical Applications of COVID-19 Autopsy Findings

- Improved diagnosis and treatment of the disease.
- The COVID 19 Diagonosis and Treatment Program (Trial Seventh Version) was issued
  1. Promoting the establishment of a multi-organ support model
  2. Strengthening the refinement of Respiratory- function management.
  3.Emphasizing the assessment and protection of immune function.

Pathophysiology of SARS-CoV-2: the Mount Sinai COVID-19 Autopsy Experience Modern Pathology 34, 1456-1467

Methods

- Here reported are the first 100 COVID19 positive autopsies performed at Mount Sinai Hospital in New York City in the time period from 20th March 2020 to 23rd June 2020.
- The autopsies were conducted in a negative pressure room utilizing both PPE and techniques recommended from the current CDC Guidance for Postmortem Specimen Collection.
- Multiple sections were cut and special stains and IHC were applied according to standard protocols.

Results

Patient Characteristics and Laboratory Data

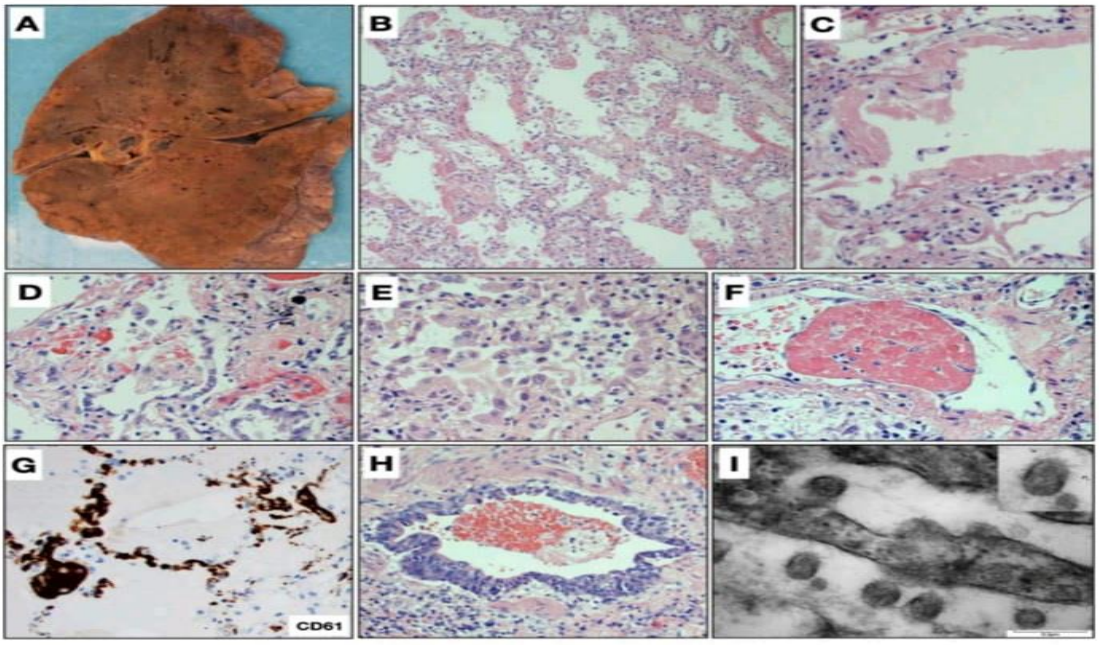
- Patients ages ranged from 29 to 94 years. Median 68
- These patients exhibited a range of preexisting conditions
- Hypertension(62%)
- Diabetes Mellitus (43%)
- Coronary Artery Disease (32%)
- Chronic Kidney Disease (30%)
- Asthma(18%)
- Heart failure (13%)
- Atrial fibrillation (10%)
- Obesity (11%)

- Confections (14%)
- Cancer (7%)
- Transplantation (6%)
- COPD (5%)
- Markers related to inflammation, including ferritin, CRP, Procalcitonin, and WBC(Neutrophil) counts were elevated.
- The absolute lymphocyte count was mildly decreased.
- Cytokines IL-6, IL-8 and TNF alpha were elevated.
- D-dimer levels were consistently elevated despite administration of anticoagulation therapy. Fibrinogen was also elevated.
- PT, aPTT and INR were also elevated.

Autopsy Findings

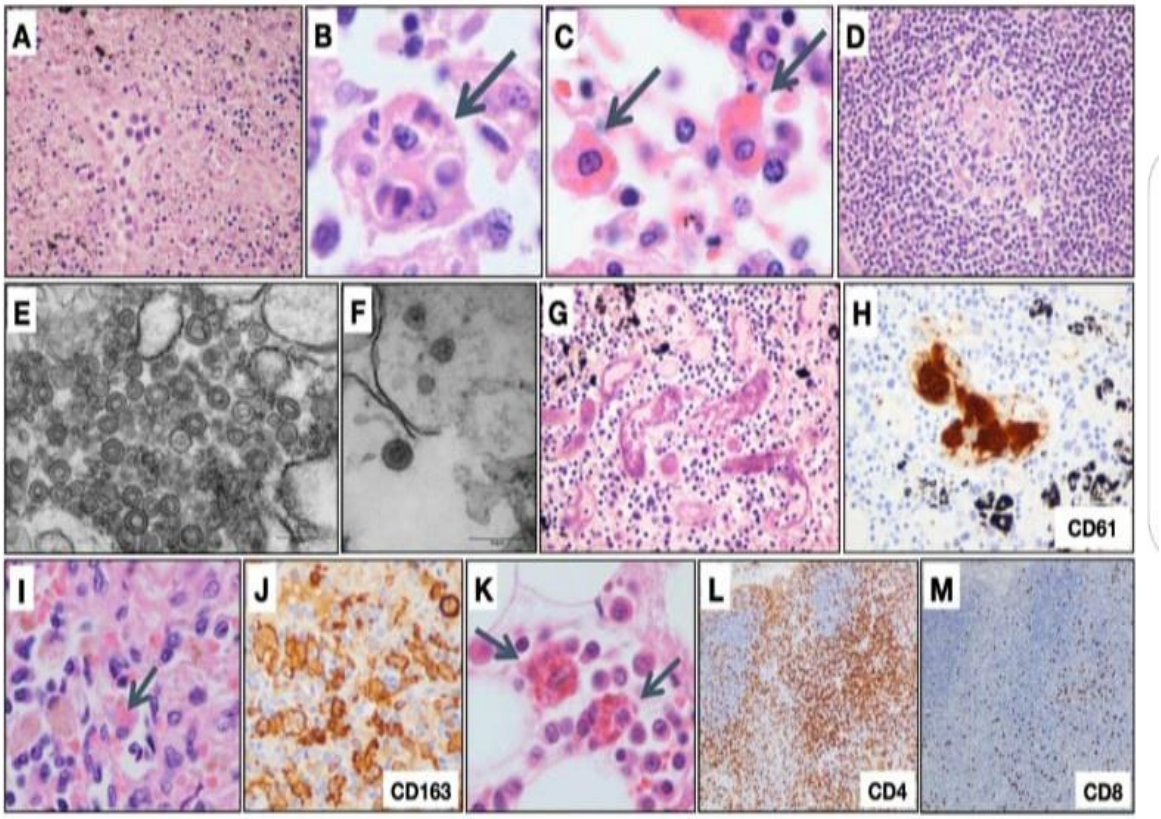
PULMONARY FINDINGS

Fig. 1: Pulmonary findings.



- **Gross**
- Patchy areas of consolidation
- Abundant edema fluid/ diffusely firm and solid
- **Microscopy**
- Diffuse alveolar damage
- Hyaline membranes
- Type 2 pneumocyte hyperplasia
- Fibrin thrombi
- Basal cell hyperplasia

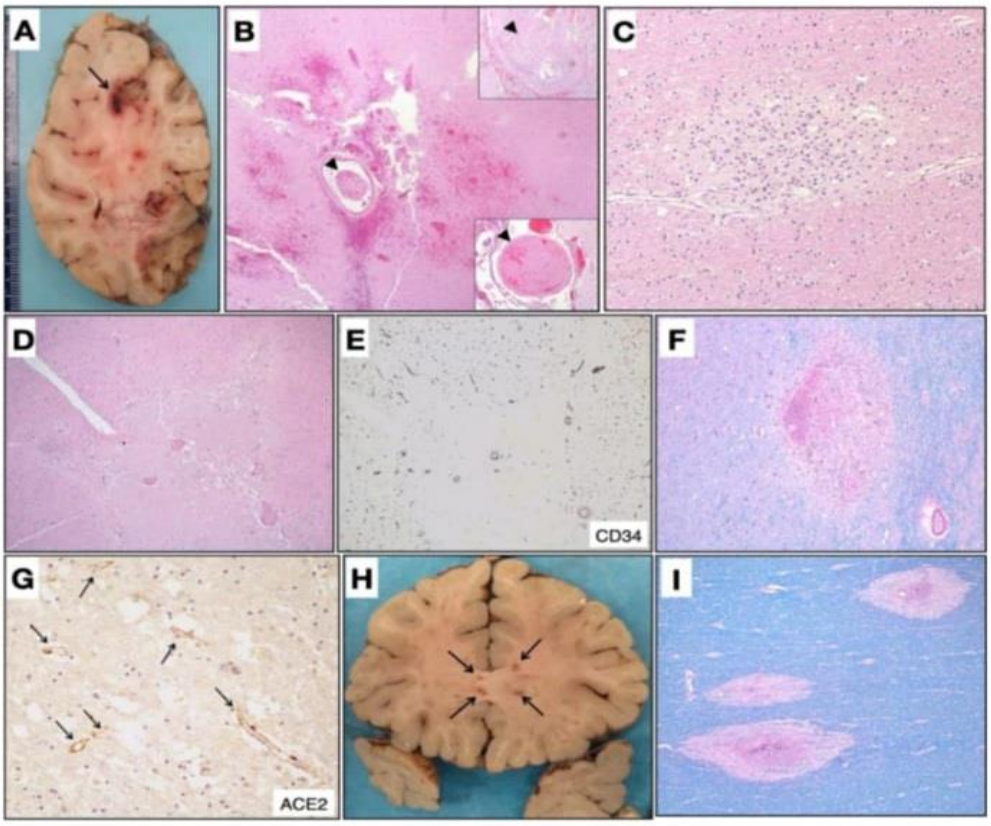
HEMATOLYMPHOID SYSTEM FINDINGS



- **Microscopy**
- Lymph node with necrosis
- Foci of hemophagocytosis
- Small depleted germinal centers
- Lymph node with microthrombi

NEUROPATHOLOGIC FINDINGS

Fig. 3: Neuropathologic findings.



- **Gross**
- Punctate hemorrhagic like lesions within the white matter
- **Microscopy**
- Acute/early-subacute infarction
- Microthrombi
- Vascular congestion

Cardiovascular System Findings

- Cardiac enlargement
- Left ventricular hypertrophy
- Moderate to marked Coronary Atherosclerosis
- Myocyte hypertrophy
- Interstitial fibrosis
- Patchy mild interstitial chronic inflammation without associated myonecrosis
- Subendocardial inflammatory infiltrate
- Small vessel thrombi

Interpretation

- The autopsy series of COVID 19 positive patients reveals that this disease, often conceptualized as a primarily respiratory viral illness, has widespread effects in the body including hypercoagulability, a hyperinflammatory state and endothelial dysfunction.
- Targeting of these multisystemic pathways could lead to new treatment avenues as well as combination therapies against SARS-CoV-2 infection.

Analysis

- After reviewing all 3 studies we conclude that
- 1. SARS-CoV-2 infection causes injuries in multiple organs and tissues with prominent and extensive pulmonary lesions.
- 2. The predominant pattern of lung lesions in patients with COVID 19 is diffuse alveolar damage, hyaline membrane formation and pneumocyte hyperplasia.
- 3. In patients existing comorbid conditions combined with the acute damage caused by SARS-CoV-2 forming the pathological basis for multiple organ dysfunction syndrome, with more serious consequences from lesions in the lungs, heart, kidneys and liver.
- 4. Importantly, the presence of platelet-fibrin thrombi in small arterial vessels is consistent with coagulopathy, seen in COVID 19 positive patients.