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The Indispensable Role of Chest Computed Tomography In 2019 Novel Coronavirus (Covid-19) Pneumonia

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19), a highly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2),began as a series of cases in Wuhan,China soon emerged as a Global COVID 19 pandemic and changed the course of the world . The gold standard for diagnosis is RT-PCR. However, a high false negative results has been reported, which would affect the timely management of suspected cases like isolation and medical treatment, further increasing the risk of persistent transmission. ChestComputed Tomography(CT) plays a crucial role in the early diagnosis of COVID-19, particularly for those patients with a negative RT-PCR and asymptomatic carriers. The initial features in CT may be associated with prognosis.

Aim of the study : Current study aimed to determine the role of CT features in relation to diagnosis,duration of infection, management and clinical prognosis in COVID-19.

MATERIALS & METHODS:A Hospital based retrospective study was performed on 160 subjects presented with clinical suspicion of COVID 19 infection, at tertiary care center Great Eastern Medical School & Hospital, Srikakulam. The clinical manifestations, epidemiologicaldata, co morbidities, laboratory parameters, oxygen requirement and CT imaging findings were analyzed.Meticulous study of Chest CT for pattern and distribution of the disease was done along with calculation of CT severity score.

RESULTS: Out of 160 subjects ,14(8%)demonstrated negative results on their first RT-PCR. 106 (66%) subjects were men, and 54 (34%) were women denoting male preponderance.135 subjects were symptomatic, of which symptoms included fever in 113 patients (83%), coughing in 78 patients (57%), myalgia in 24 patients (17%), shortness of breath in 34 patients (25%), and diarrhea in 29 patients (21%).17(68%) of asymptomatic subjects showed Ground glass opacities. Out of 160 subjects,18 subjects showed normal chest pattern.in the remaining the most common radiographic features were Ground glass opacities(86.6%),consolidation(37.3%),crazy paving/intralobar septal thickening(63.3%) pattern, and subpleural reticular bands(26.7%).The patients with mean CT severity score of 10.7 were able to maintain adequate oxygen saturation in room air, whereas Mean CT severity score of 23.2 and additional comorbidities needed intubation.

CONCLUSION: Imaging features of multiple patchy areas of ground glass opacity and consolidation predominately in the periphery of the lungs are characteristic manifestations on chest CT and extremely helpful in the early detection and diagnosis of this disease, which aids prompt diagnosis and the eventual control of this emerging global health emergency.The use of chest CT as the main screening method in epidemic areas is recommended as it provides a fast, convenient, and effective method to early recognize suspicious asymptomatic cases. CT severity score found to be useful in guiding the clinician in treatment protocols.

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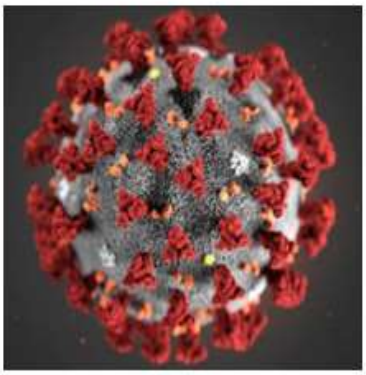
I. INTRODUCTION

- COVID-19 (coronavirus disease 2019) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a strain of coronavirus.
- Virus belongs toFamily – Coronaviridae,Subfamily-Orthocoronaviridae,Order – Nidovirales,Class – Betacoronavirus,Subgenus- Sarbecoviridae.
- The SARS-CoV-2 virus, like the closely-related MERS and SARS coronaviruses, effects its cellular entry via attachment of its virion spike protein (a.k.a. S protein) to the angiotensin-converting enzyme 2 (ACE2) receptor.
- This receptor is commonly found on alveolar cells of the lung epithelium, underlying the development of respiratory symptoms as the commonest presentation of COVID-19



- It is thought that the mediation of cardiovascular effects is also via the same ACE2 receptor, which is also commonly expressed on the cells of the cardiovascular system.
- COVID-19 robustly triggers the expansion of IFN inducible genes that assist in host antiviral protection.
- Excessive immune response in host-hypercytokinemia - **cytokine storm**, which leads to excessive tissue damage.The protagonist of this storm- **Interleukin -6.**
- Death usually by acute respiratory distress syndrome, sepsis and multi-organ failure.
- Young patients exhibit early IFN-1 response compared to old patients.

Human-human transmission occurs through respiratory droplets from coughing and sneezing.Aerosol transmission possible in case of protracted exposure to elevated aerosol concentrations in closed spaces. i.e. airborne transmission.Increasing evidence base to show that aerosols are also produced by talking, singing, coughing and expiration.

The diagnosis is made by a positive PCR test, which is highly specific.

CT has a higher sensitivity but lower specificity and can play a role in the diagnosis and treatment of the disease.

CT can play a role in:

- Triage of patients: - no COVID-19, possible or most likely COVID-19
- clinical suspicion in patients with negative PCR.
- severity of the disease
- Prediction of worsening
- Prediction of improvement

II. MATERIALS AND METHODS

It is a retrospective study with a totalnumberof160patientsreferredwithclinical suspicion of covid 19 pneumonia based on their clinical smptoms like cough,fever,myalgia and on subjects on contact with diagnosed covid 19 infection for quarantine purpose. All patients imaged with 16 slice GECT machine in theDepartment of Radiology , Great Eastern Medical School andHospital,Srikakulamoveraperiodof3months.

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Inclusioncriteria : Patientswithclinical suspicion of covid 19 pneumonia

Exclusioncriteria : Pregnant female patients**.**

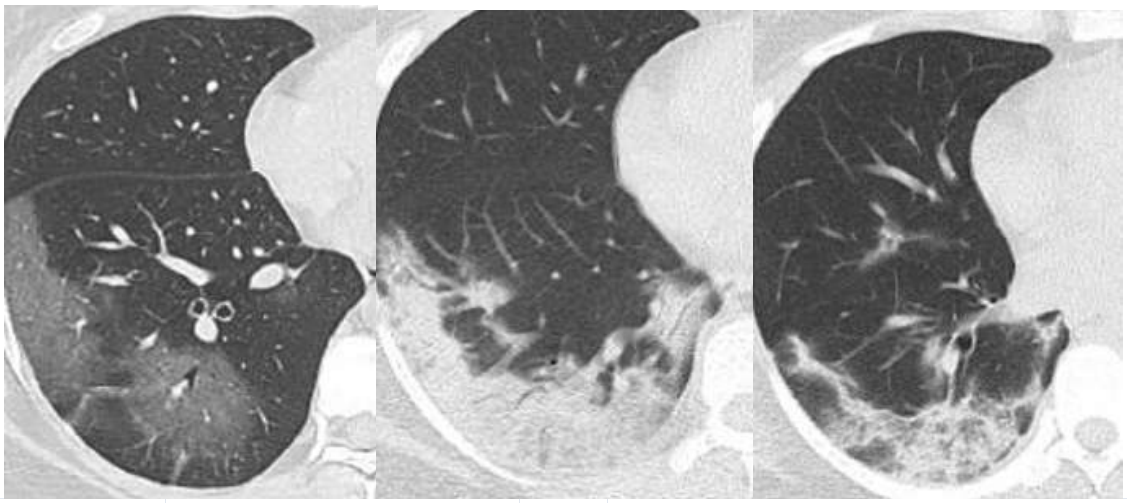
Method :
After obtaining informed consent, general dataregarding age, sex, symptoms, history of presentillness, past and personal history, travel history were noted. Any contact with diagnosed covid infection patients is also noted. The clinical manifestations, presenting symptoms,progression of symptoms ,new symptoms ,oxygen requirement, ICU admission, duration of symptoms ,duration of ICU stay were meticulously noted.

Dataanalysis
Statistical analysis of the data was performed yusingMicrosoft Excel. Data was represented in the formoffrequenciesandpercentages with the help of tables, bar diagrams.

Imaging findings

- **The severity of the lung involvement on the CT correlates with the severity of the disease.**
- Initial CT-findings in COVID-19 cases include bilateral, multilobar ground glass opacification (GGO) with a peripheral or posterior distribution, mainly in the lower lobes and less frequently in the middle lobe
- **Four stages on CT have been described:**

1. **Early/initial stage (0-4 days): normal CT or GGO only; up to half of patients have normal CT scans within two days of symptom onset**
2. **Progressive stage (5-8 days): increased GGO and crazy paving appearance**
3. **Peak stage (9-13 days): consolidation**
4. **Absorption stage (>14 days): With an improvement in the disease course, "fibrous stripes" appear and the abnormalities resolve at one month and beyond**



Visual assessment

The severity on CT can be estimated by visual assessment.

This is the easiest way to score the severity.

The CT images show a 25% involvement by visual assessment.

Severity score

Another method is by scoring the percentages of each of the five lobes that is involved:

1. < 5% involvement
2. 5%-25% involvement
3. 26%-49% involvement
4. 50%-75% involvement
5. > 75% involvement.

The total CT score is the sum of the individual lobar scores and can range from 0 (no involvement) to 25 (maximum involvement), when all the five lobes show more than 75% involvement.

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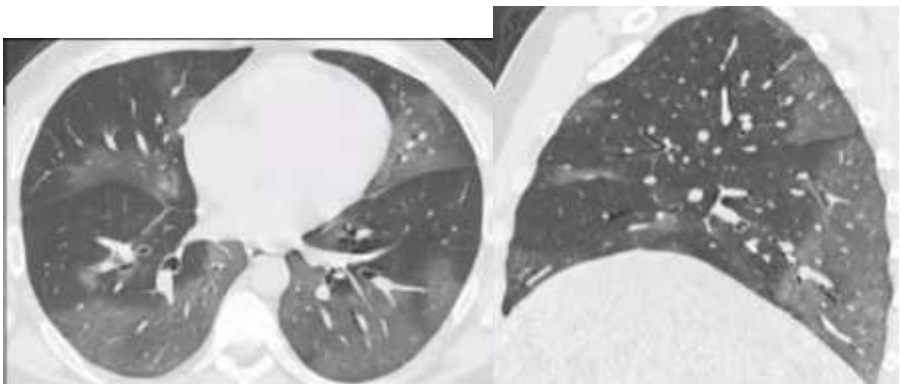
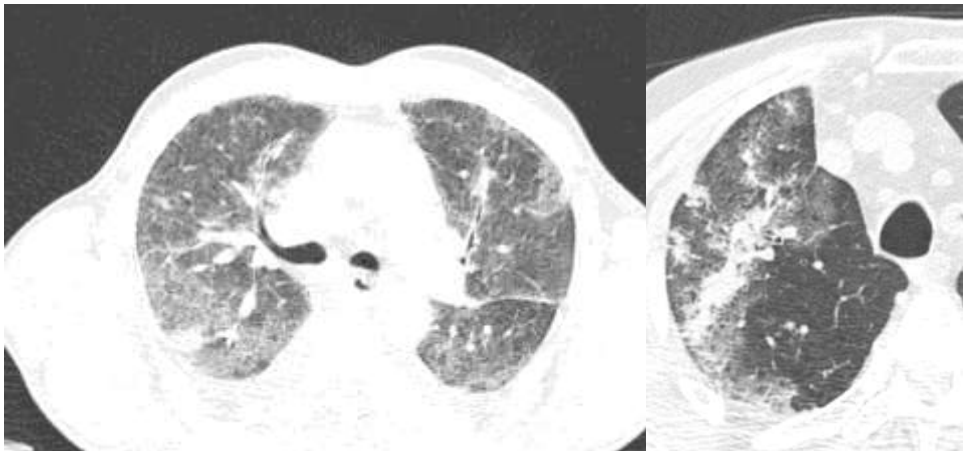
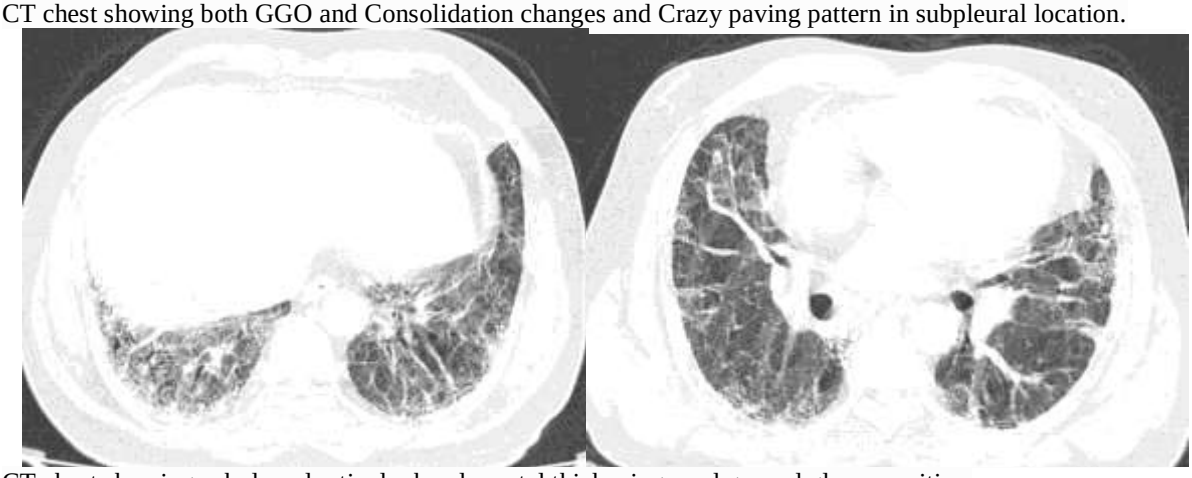


CT chest showing typical ground glass opacities predominantly in subpleural location in consistent with covid 19 pneumonia.



CT chest showing both GGO and Consolidation changes and Crazy paving pattern in subpleural location.



CT chest showing subpleural reticular bands,septal thickenings and ground glass opacities.

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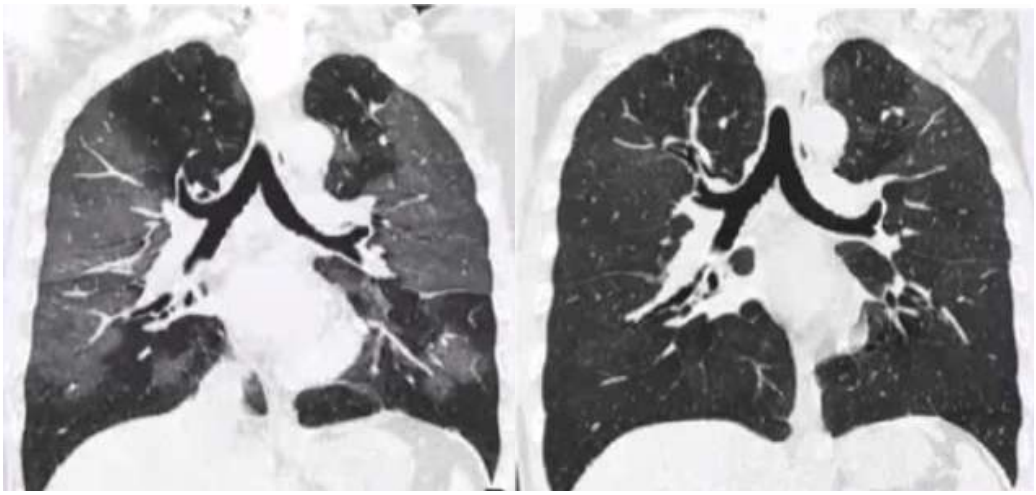
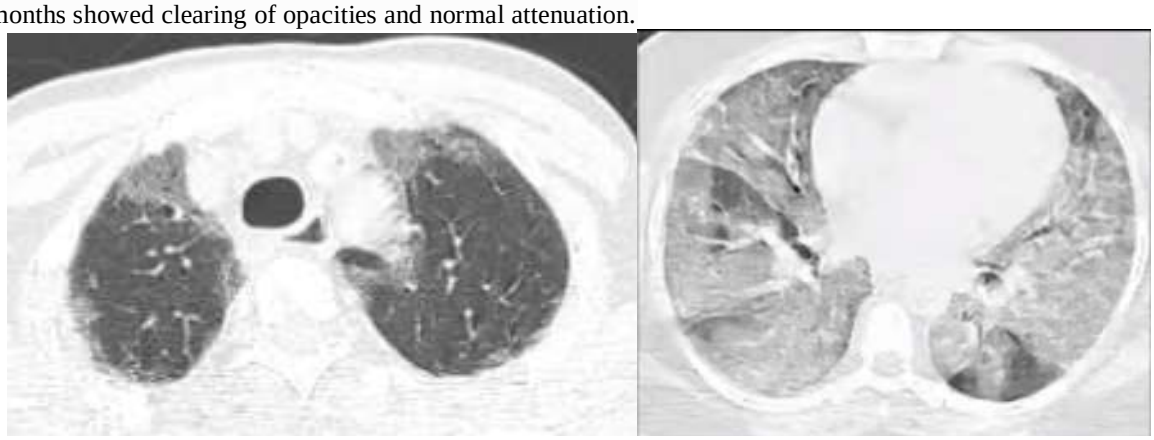
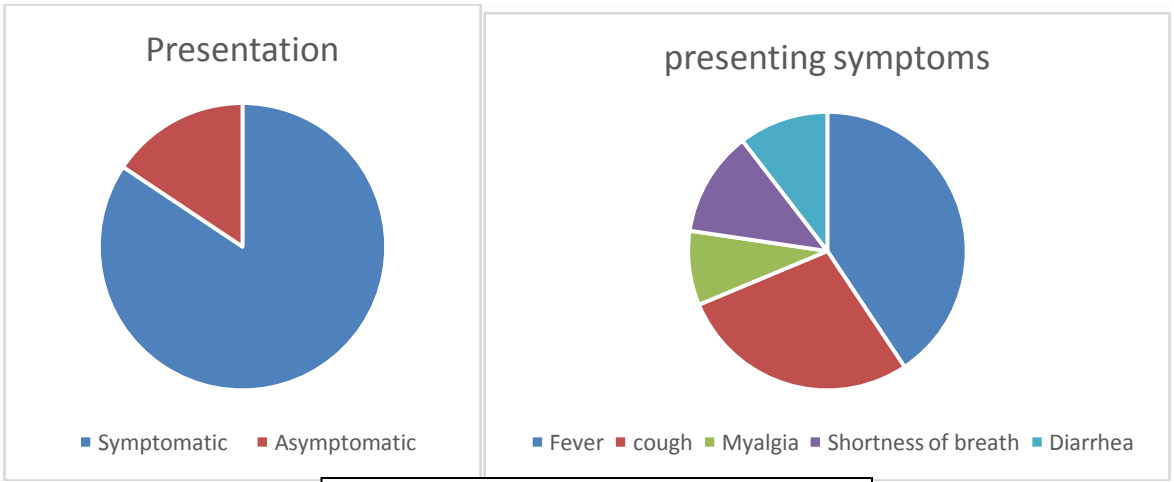


CT chest showing peripheral subpleural ground glass opacities and same patient CT on further followup after 3months showed clearing of opacities and normal attenuation.



CT chest in the earlier phase showed peripheral GGO and later followed by worsening of symptoms and showing complete involvement of all the lobes of bilateral lungs having CT severity score of 24.

Results:



Out of 160 subjects , 135 showed symptoms and 25 were asymptomatic.

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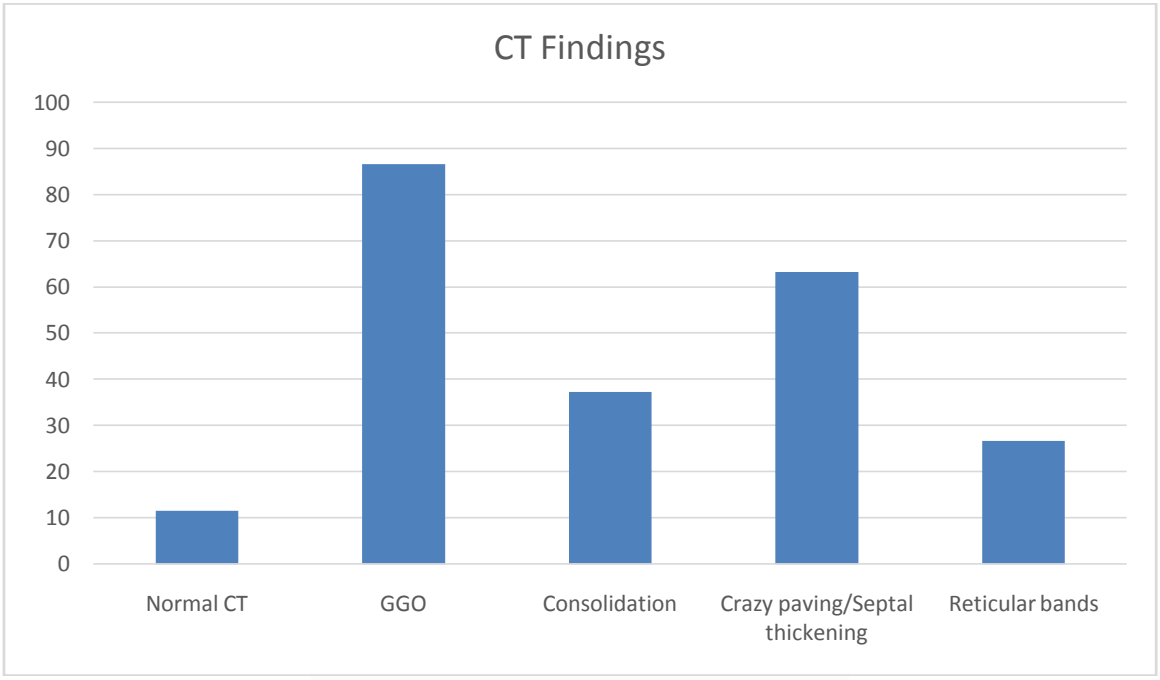
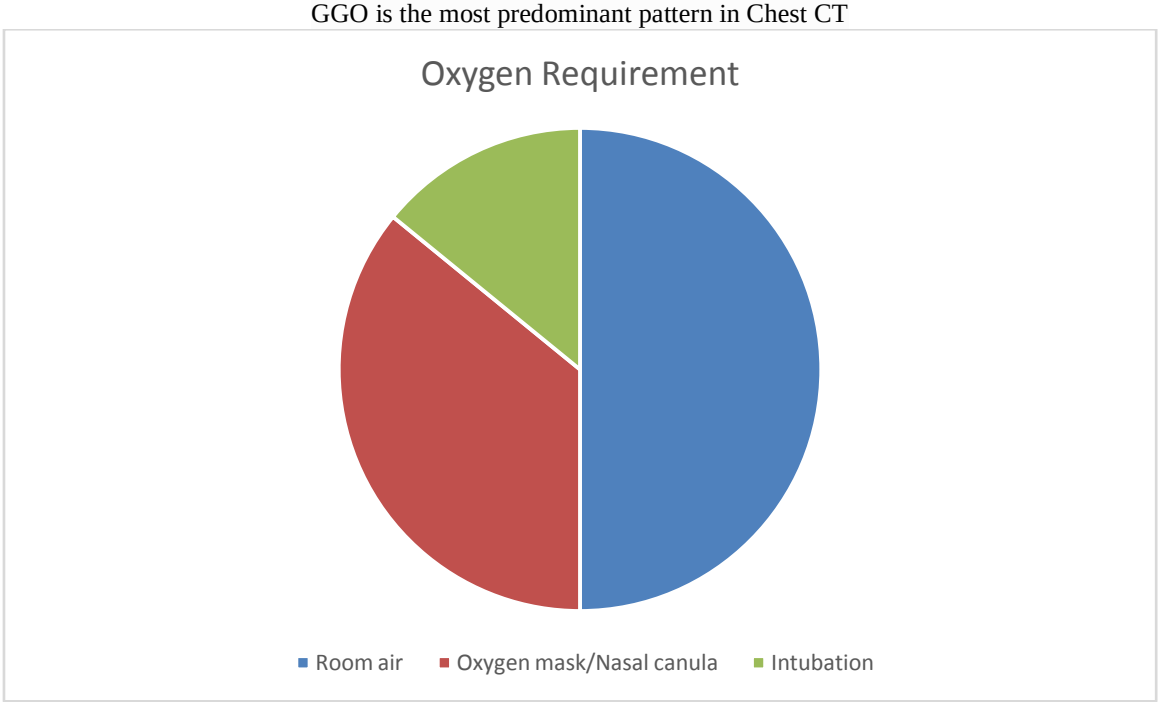


GGO is the most predominant pattern in Chest CT



The patients with mean CT severity score of 10.7 were able to maintain adequate oxygen saturation in room air, whereas Mean CT severity score of 23.2 and additional comorbidities needed intubation.

III. DISCUSSION:

Chest imaging plays a fundamental role in patients with COVID-19 pneumonia not only for assessing the presence and evolution of pulmonary abnormalities but also for defining the severity of disease and predicting patient outcome.

The pivotal role of chest imaging in COVID-19 patients has been evaluated and confirmed in numerous studies; some of them aimed at correlating imaging findings with clinical features and the severity of disease, whereas others focused on the correlation between imaging findings at admission (or in the emergency department) and patients' outcome to identify

factors predictive of disease progression, ICU admission, or death.

Early imaging (Immediately 0-2 days after symptom onset) yielded no findings even on chest CT.As time progresses, imaging findings vary and increase in frequency and severity following a temporal pattern.An overwhelming majority of discharged patients had residual disease on final CT scans, with ground-glass opacities being the most common pattern.

IV. CONCLUSION:

Imaging features of multiple patchy areas of ground glass opacity and consolidation predominately in the periphery of the lungs are characteristic manifestations on chest CT and extremely helpful in the early detection and diagnosis of this disease, which aids prompt diagnosis and the eventual control of this emerging global health emergency.The use of chest CT as the main screening method in epidemic areas is recommended as it provides a fast, convenient, and effective method to early recognize suspicious asymptomatic cases. CT severity score found to be useful in guiding the clinician in treatment protocols.Chest imaging can also help in the assessment of disease severity and prediction of patient outcome, either as an independent factor or in combination with clinical and laboratory features.

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