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KEY WORDS: GGO – Ground Glass opacity , SARS- COV2 – Severe Acute Respiratory Syndrome Corona Virus 2 ,VALI - Vaping associated lung Injury , ED – Emergency Department .

GROUND GLASS OPACITY- (GGO) MIMICS AND ITS CHAMELEONS IN THE ED A LITERATURE REVIEW !

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ABSTRACT

Background : The COVID-19 pandemic has created an unprecedented health care crisis with, disruptions in both routine and emergency health care delivery and immense strain on health care resources . The clinical spectrum of disease with coronavirus disease (COVID-19) infection is variable and ranges from an asymptomatic infection or mild upper respiratory tract illness to severe viral pneumonia with respiratory failure and occasionally death. In a resource-constrained environment with a high community burden of the disease and rapid point-of-care testing either unavailable or showing negative results, CT has been used to rapidly triage patients into non COVID-19, possible COVID-19, or most likely COVID-19 . As per the Fleischner Society consensus statement, CT is appropriate in certain scenarios, including for patients who are at risk for and/or develop clinical worsening .The common chest CT findings of COVID-19 are multiple ground glass opacity(most common), consolidation and interlobular septal thickening in both lungs, which are mostly distributed under the pleura. The ground-glass opacities are usually peripherally located with the lower lobes being commonly involved. Imaging differentiation is important for management and isolation purposes and for appropriate disposition of patients . (1,7) The purpose of this article is to discuss the common presentations of emergency department with ground glass opacities and to review the differential diagnosis of typical imaging findings of COVID-19. **Conclusion :** Ground glass opacities appear in a variety of disease processes of emergency department presentations . Not all presentations with GGO''s have SARS COV2 or Covid -19 viral pneumonia .

INTRODUCTION :

Coronavirus disease 2019 (COVID-19) outbreak was first reported in Wuhan -China and has become widespread around the world just within a month. It was declared as a global public health emergency by the WHO on March 11 2020 . COVID-19 has a wide spectrum of clinical severity, data classifies cases as mild , severe or critical . Many patients present with pronounced arterial hypoxemia yet without proportional signs of respiratory distress, they not even verbalize a sense of dyspnea .This phenomenon is referred as silent or 'happy' hypoxemia.[5]

The disconnect between the severity of hypoxemia and the relatively mild respiratory discomfort reported by the COVID-19 patients contrasts with the experience of physicians usually treating critically ill patients in respiratory failure . Happy or silent hypoxemia is not exclusively seen in COVID-19, but may also occur in patients with atelectasis, intrapulmonary shunt (i.e. arterio-venous malformations) or right-to-left intracardiac shunt. The adequacy of gas exchange is primarily determined by the balance between pulmonary ventilation and capillary blood flow, referred as ventilation/perfusion (V/Q) matching . In the initial phase of COVID-19, several mechanisms contribute to the development of arterial hypoxemia without a concomitant increase in work of breathing. Rapid clinical deterioration may occur. At the bedside, a profound understanding of the clinical and pathophysiological determinants of respiratory drive and hypoxemia and early rapid screening may promote a more complete comprehension of a COVID-19 of a patient's clinical presentation and timely management.[5,8]

Imaging was not routinely indicated as a screening test for Covid-19 in asymptomatic patients, but few guidelines have endorsed the use of imaging in patients with moderate-to-severe features of Covid-19 regardless of nucleic acid test results, and also supported the use of imaging in patients with worsening respiratory status.[7]

COVID-19 pneumonia manifests with chest CT imaging abnormalities, even in asymptomatic patients, with rapid evolution from focal unilateral to diffuse bilateral ground-glass opacities that progressed to or co-existed with consolidations within 1-3 weeks. Given the lack of specificity of chest CT findings for COVID-19, makes it imperative for emergency physicians to discuss and differentiate GGO mimics in the ED .

The purpose of this review is to address the range of pulmonary disease processes that can mimic the CT appearance of COVID-19 pneumonia .

We present a series of cases associated with chest CT findings of GGO ''s and their varied presentation in the ED.

CASE 1 : A 62 year female patient presented to ED with fever, dry cough since 1 day ,no associated symptoms .**Primary Survey** : Airway -patent , Breathing – RR- 26 /min , Spo_2- 91 % ,Circulation :Pulse -97/ min , BP – 120/80 mm Hg , Disability - GCS -15/15 ,Exposure – Nil significant .*Interventions :* Oxygen administration . *Preliminary Investigations* : ABG , CBP , Chest X ray , ordered. **Secondary Survey**: *General examination* - moderately built and nourished , HEENT -WNL , *Systemic Examination*: CVS – S1 S2 present , RS – BAE present , basal crepitations present , GIT – P/A Soft no organomegaly CNS – NAD . **AMPLE H/o** – hypertension , diabetes mellitus present, last meal 3 hrs ago , no events. ***Provisional diagnosis*** :Lower respiratory tract infection , Severe acute respiratory illness of Covid -19 , Community acquired Pneumonia ,Pyrexia for evaluation – R/o Dengue ,Malaria , Scrub Typhus. *Definitive Investigations* : CT Thorax , CBP , Basic Metabolic Panel , Reverse Transcriptase polymerase chain reaction of respiratory specimens for Covid -19 , CRP ,LDH ,D -dimer and Serum Ferritin levels .

CASE 2 : A 70 year old male patient presented to ED with sudden onset chest pain ,shortness of breath since 2 hours , associated symptoms – dry cough .**Primary Survey** : Airway -

patent , Breathing – RR- 38 /min , Spo_2 88% , Circulation : Pulse - 75/ min ,BP – 140/70 mm Hg , Disability -GCS -15/15 ,Exposure – Nil significant . *Interventions :* Oxygen administration . *Preliminary Investigations* : ABG ,ECG, ,Troponin I ,Chest Xray .**Secondary Survey** : ***General examination*** – Moderately built and nourished , HEENT : pallor present , JVP -WNL ***Systemic Examination***: CVS – S1 S2 present S3 gallop present, RS – Bilateral Air entry present , rales present bilaterally, GIT – P/A soft no organomegaly , CNS – NAD . **AMPLE H/o** – hypertension present , last meal – 2hrs ago, no events ***Provisional diagnosis*** : Acute Coronary syndrome with pulmonary edema, Severe acute respiratory illness of Covid -19 , Acute Heart failure ,R/o Pulmonary Embolism .*Definitive Investigations* : 2D ECHO , CT Thorax , CBP , Basic Metabolic Panel , Reverse Transcriptase polymerase chain reaction of respiratory specimens for Covid -19 , CRP ,LDH ,D-dimer levels.

CASE 3 : A 20 year old male patient presented to ED with history of trauma due to accident followed by pain and injury to the chest region , associated symptoms – cough , dysnoea.**Primary Survey** : Airway -patent , Breathing – RR- 33 /min , Spo_2 87% , Circulation : Pulse -118/ min ,BP – 80/50 mm Hg , Disability -GCS -15/15 ,Exposure – abrasions and lacerations present on the face and chest region . *Interventions : C Spine stabilization* ,Oxygen administration , IV line secured , fluid resuscitation .*Preliminary Investigations* : E Fast Scan , ABG , Chest Xray .**Secondary Survey** : No visible head injury , C spine tenderness was absent, Chest Compression Test was positive , tenderness was present bilaterally in lower chest region, abdomen was soft nontender , Pelvic Compression test was negative , Extremities - WNL , all peripheral pulses were present .**AMPLE H/o** – Nill significant , last meal -2hrs ago, preceding events – motor vehicle collision ,*General examination* – Well built and nourished ,HEENT : no visible injury and no active bleeding .*Systemic Examination*: CVS – S1 S2 present , RS – Bilateral air decreased in basal region , GIT – P/A soft no tenderness, CNS – NAD .***Provisional diagnosis*** : Road Traffic accident with Blunt Injury chest R/0 Severe acute respiratory illness of Covid -19 , *Definitive Investigations* : CT Thorax , Basic Reverse Transcriptase polymerase chain reaction of respiratory specimens for Covid -19 , CBP, Basic Metabolic Panel tests , CRP ,LDH ,D-dimer levels.

CASE 4 : A 55 year female patient presented to ED with cough ,shortness of breath since 10 days , associated symptoms – low grade fever,**Primary Survey** : Airway - patent , Breathing – RR- 29 /min , Spo_2 88% , Circulation : Pulse - 112/ min ,BP – 100/70 mm Hg , Disability -GCS -15/15 ,Exposure – Nil significant . *Interventions :* Oxygen administration .*Preliminary Investigations* : ABG ,Chest Xray , CBP . **Secondary Survey** : *General examination* - Obese ,well built and nourished , HEENT : pallor present. *Systemic Examination*: CVS – S1 S2 present , RS – Air entry decreased bilaterally , GIT – P/A soft no organomegaly , CNS – NAD , **AMPLE H/o** – hypertension present , last meal 4hrs ago , no events .***Provisional diagnosis*** : Severe acute respiratory illness of Covid -19 ,Lower respiratory infection , Community acquired Pneumonia .*Definitive Investigations* : CT Thorax , CBP , Basic Metabolic Panel , Reverse Transcriptase polymerase chain reaction of respiratory specimens for Covid -19 , CRP ,LDH ,D-dimer and Serum Ferritin levels , Sputum examination .

DISCUSSION :

The ongoing coronavirus disease 2019 (COVID-19) pandemic, a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has necessitated a need for timely and rapid diagnostic performance tests for detecting COVID-19. The reference standard for diagnosing COVID-19 is a SARS-CoV-2 real-time reverse-transcription polymerase chain reaction (RT-PCR) test of respiratory tract specimens. Unfortunately, RT-PCR has limited sensitivity, and clinical test performance is dependent on test sample quality, viral load kinetics, and duration of symptoms . Although debatable with varied recommendations , CT is widely available and offers the potential for fast triage and robust rapid diagnosis with limited burden to patients.[4]

Commonly reported CT findings of SARS-CoV-2 - Covid-19 include bilateral pulmonary opacities distributed in the peripheral lower lung. In typical cases, bilateral ground-glass opacities, sometimes with areas of consolidation are present, and they can have an appearance suggestive of organizing pneumonia. In the early stage CT shows predominantly show unilateral or bilateral ground-glass opacities accompanied with enlarged small vessels. The opacities can be multifocal, are often rounded, and can have the reversed halo sign . As the disease progresses, some of the original ground-glass opacities begin to consolidate. Thus, ground-glass opacities and focal areas of consolidation are commonly seen ,if the patients did not receive effective treatment promptly or in immunosuppressed state, COVID-19 pneumonia may be life-threatening and CT images often show diffuse opacities to be present in both lungs and in severe cases so-called white lung manifestation.[2,4]

Ground-glass opacities (GGO) are radiologic findings with ill defined areas of slightly increased computed tomographic attenuation caused by displacement of air from alveolar spaces with preservation of normal lung broncho vascular structures and their margins . Atelectasis ,fluid ,interstitial thickening and increased blood flow in the lung parenchyma cause such opacities . In any case, identification of ground-glass opacity depends on skill and expertise and hardly ever problematic. The use of the term ground glass derives from the industrial technique in glassmaking hereby the surface of normal glass is roughened by grinding it. A wide variety of physiological and pathological findings contribute to the development of ground glass opacities . Actively trying to differentiate between acute and chronic ground-glass opacities is very helpful for narrowing the differential diagnosis. Common acute etiologies include infection, alveolar hemorrhage, and edema. Common chronic causes include idiopathic interstitial pneumonias , respiratory bronchiolitis , interstitial lung disease.[1,2]Other rare causes include hypersensitivity pneumonitis, vasculitis, lipoid pneumonia, Vaping associated lung injury , (VALI) neoplastic processes with a lepidic proliferation pattern, aspergillosis etc.[6]

The reversed halo sign is a focal rounded area of ground-glass opacity surrounded by a ring of consolidation This sign was first described as a finding on high-resolution CT that is specific for cryptogenic organizing pneumonia. The reverse halo sign has been reported in association with a wide range of pulmonary diseases, including secondary organizing pneumonia, pulmonary infarction, infections (E.g, community-acquired pneumonia, Viral pneumonia, tuberculosis, invasive fungal infections -paracoccidioidomycosis, histoplasmosis, cryptococcosis, and pneumocystis pneumonia), lung cancer, metastatic disease, lymphomatoid granulomatosis with polyangiitis, and sarcoidosis.[3,9]

Certain radiographic findings like pleural effusions, interstitial thickening, and lobar consolidation are considered to be atypical of Covid-19 .[7,9]

However, it is pertinent to know that, in the initial stages the features on CT images of Covid -19 patients may not always correlate with the results of RT-PCR tests , and may not be consistent with their clinical symptoms in another set of patients .[11]

But as per various trials and study results when the result of the RT-PCR test is negative for a patient with CT features

typical of viral pneumonia and history of potential exposure, the patient should be isolated, closely observed, and undergo further RT-PCR testing.[12]

In the present scenario the chest CT findings of Case 1 were bilateral multilobar GGO"s consistent with Covid -19 Viral pneumonia (Fig -1)and reverse transcriptase test was positive for it , the patient was stabilized in the ED and was treated accordingly .

In Case 2 the chest CT findings were GGO's ,bilateral in perihilar region likely suggestive of pulmonary edema (Fig -2),troponin I was positive and Echo findings were suggestive of acute coronary syndrome and reverse transcriptase test was negative for Covid-19 and inflammatory markers were within normal limits . The patient was stabilized with oxygen ,nitroglycerin, diuretics and antiplatelets and was later transferred to cardiology department.

In Case 3 the chest CT findings were GGO's in dependant lung regions secondary to trauma suggestive of bilateral effusion was diagnosed as blunt injury chest with minimal hemothorax(Fig -3) ,reverse transcriptase test was negative for Covid-19 and inflammatory markers were within normal limits .The patient was stabilized and treated accordingly .

Case 4 the chest CT findings were GGO's , bilateral apical and sub pleural in location with linear soft tissue opacities along bronchovascular bundle and was diagnosed as allergic broncho pulmonary aspergillosis(Fig -4) and reverse transcriptase test was negative for Covid-19 and inflammatory markers were within normal limits . The patient was stabilized in the ED and was transferred to respiratory medicine department .

CONCLUSION:

The typical chest CT imaging features of Covid -19 , typical - ground glass opacities overlap with a wide variety of emergency department presentations .

The diagnostic sensitivity of CT in identifying Covid-19 lesions is high , but is less specific and is similar to other infectious and noninfectious diseases .

In view of the ongoing Covid-19 pandemic the use of a combination of clinical signs ,history, imaging findings ,rapid diagnostic tests , inflammatory markers and other advanced radiological software technologies are of key importance and aid in the accuracy of diagnosis .

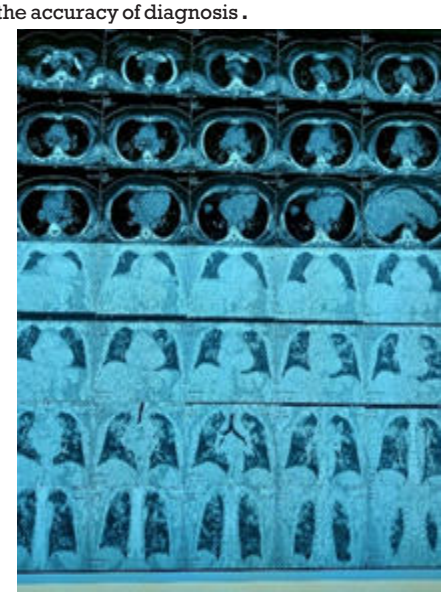

Fig :1 C T Thorax with bilateral GGO's likely suggestive of Covid- 19 Viral pneumonia.

Fig : 2 CT Thorax with Ground glass opacities in perihilar regions bilaterally likely suggestive of Pulmonary Edema

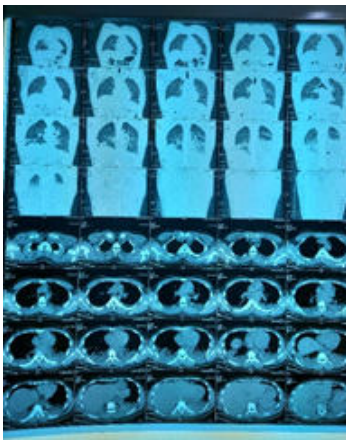

Fig : 3 CT Thorax with Ground glass opacities in dependant lung regions likely suggestive of bilateral effusions with lung contusions secondary to trauma ,R/o consolidations secondary to aspiration or infective etiology.

Fig : 4 CT Thorax with bilateral GGO"s likely bronchocele with mucoid impaction likely Allergic Broncho Pulmonary Aspergillosis.

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