

CT CHEST RECONSTRUCTION IMAGES FOR PATIENTS WITH SINGLE AND MULTIPLE BILATERAL GROUND GLASS OPACITIES (GGO) AND THE CHANGES OF C- REACTIVE PROTEIN (CRP) IN CORONA VIRUS COVID-19

MOHAMED S. NASR ELDIN

Radiology and Medical Imaging, Faculty of Applied Health Sciences Technology-October 6 University.

HALA M. AHMED

Medical Biophysics - Biomedical Equipment, Faculty of Applied Health Sciences Technology-October 6 University.

MUSTAFA. A. SOULA

Radiobiology department. Faculty of Applied Health Sciences Technology-Badr University in Cairo.

Abstract:

Background: The purpose of this research was to examine and evaluate the ability of complete blood cells, coagulation, and biochemical tests of interleukin-6, 8, and If- in patients with the virus (COVID-19) in Egypt (Third wave), as well as to assess the findings of the Ct scans. **Methods:** Fifty patients were used (30 females, 20 males, and ten control groups). In patients with the virus (COVID-19) in Egypt (Third wave), we measured total blood cells, coagulation, and biochemical tests of interleukin-6, 8, and If-, as well as the results of the CT scans. **Results:** patients with the virus (COVID-19) had significantly higher white blood cell (WBC), neutrophil, and lymphocyte counts, compared to the control group. The COVID-19 virus in patients in Egypt also caused a significant increase in coagulation measurements, liver profile and kidney profile function, and biomarkers of inflammation (Third wave). Both interleukin expressions (IL-6 and IL-8) were elevated in COVID-19 virus-infected patients with significant inflammatory activity. There was no statistically significant difference between the proportion of male and female COVID-19 patients with interleukins (IL-6, IL-8, and IF-) at their maximum levels. **Conclusions:** We recommend that white blood cell (WBC) count, neutrophil count, lymphocyte count, and IL-6, IL-8, IF-y, serum ferritin, and C-reactive protein (CRP) as markers for highly potential progression to critical illness in patients virus (COVID-19) in Egypt (Third wave) who are very ill and the virus is positively spreading between families or friends.

Keywords: virus (COVID-19), CRP, ESR, WBC count, Interleukins, CT.

Introduction: -

Egypt was officially informed that the COVID-19 virus had appeared on February 14, 2020. The virus (COVID-19) pandemic in Egypt is a component of the global coronavirus (COVID-19) pandemic that is responsible for the severe acute respiratory syndrome (SARS-CoV-2).

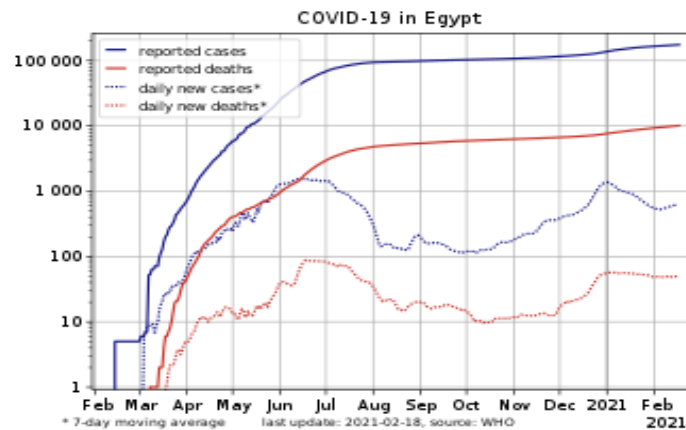


Fig.1: Chart showing the number of virus (COVID-19) cases and deaths in Egypt. Logarithmic Scale. For related charts and data sources see User: Hbf878# virus (COVID-19).

Respiratory diseases are typically brought on by the family Coronavirus (COVID-19) disease around the world (Corman et al., 2019). Wuhan region was hazardous in December 2019 due to a new contagious respiratory disease in the area, specifically (Wuhan) (Huang et al., 2019& Wang et al., 2020). In roughly 30% of instances, the virus (COVID-19) infection results in acute respiratory distress, which affects the respiratory system, particularly the lungs (Huang et al., 2019). Specifically, some devices are used in medical imaging. The evaluation and assessment of the virus (COVID-19) often precede the emergence of clinical symptoms and indicators, making chest computed tomography (CT) essential (Pan et al., 2020). Recent studies have demonstrated the predictive utility of chest CT, showing that a particular CT scan score may accurately predict a patient's mortality after contracting the COVID-19 virus (Yuan et al., 2020). In some instances, any alterations in the lung characteristics on the subsequent CT scan have been mentioned (Wei et al., 2019; Pan et al., 2020).

SARS-CoV, a brand-new coronavirus, was identified as the germ responsible for the outbreak (Ksiazek et al., 2003). IL-6 plays a crucial role in controlling inflammatory, and immune reactions (Chen et al., 2001; Tanaka et al., 2014) The lung fibroblasts, T lymphocytes, type II pneumocytes, alveolar macrophages, and lung parenchyma are among the cells that produce (IL-6). Since IL6 is an acute-phase inflammatory cytokine, it is possible that assessing circulating IL-6 will help determine how inflamed the lungs are (Chen et al., 2001; de Brito et al., 2016).

C-reactive protein (CRP) is a serum inflammatory biomarker that has been extensively researched in various illnesses, including influenza, malaria, HCV, and HBV (AddaiMensah et al., 2019; Badawi & Vasileva, 2019). Increased CRP has been linked to a high risk of developing cancer, the advancement of the disease, and a decreased chance of surviving the disease (Siemes et al., 2006; Allin et al., 2011; Hall et al., 2013; Iivanainen et al., 2019; Weber et al., 2019).

Aim of the work: -

This work is to find and quantitative description hematologic, coagulation & inflammatory, biochemical studies of (IL-6, IL-8 & IF- γ) and finding the CT medical imaging in patients with virus (COVID-19) in Egypt (Third wave).

Materials and methods: -

1- Patients virus (COVID-19): -

A total of 50 viruses (COVID-19) patients (≥ 18 years old) were enrolled from October 6 University Hospital, Giza, Egypt. On the other hand, the study protocol was approved by the local ethics committee of October 6 University Hospital, Egypt. The patients were divided into three main groups; the first group included 30 female (50%) virus (COVID-19) patients. The second group was submitted to 20 males (33.3%) virus (COVID-19) patients, and the third group was ten control group (16.6%).

2- Data collection: -

Serum samples were obtained by force centrifugation at (2000 rpm for 10 minutes). Serum samples were divided into two aliquots, one for biochemical analysis and cytokines. Routine laboratory investigations (Liver and kidney function tests as (Aspartate, aminotransferase (AST), Alanine, aminotransferase (ALT), Albumin, Total bilirubin, urea and creatinine) were measured using ALCYON 3000 I analyzer, Abbott laboratories, Spinreact kits (Ctra, Santa Coloma, Espana) (Bergmeyer **et al.**, 1978). Coagulation (Prothrombin time, D-dimer, Troponin). Hematologic (WBC count, Neutrophil count, Lymphocyte count, Hemoglobin). Highly inflammatory biomarkers (Erythrocyte sedimentation rate (ESR), C reactive protein (CRP), Serum ferritin. The detailed information on medical history, signs and symptoms. In medical imaging, especially some machines, Chest computed tomography (CT) scans on admission were recorded.

3- Cytokines determination: -

The cytokines (IL-6, IL-8 & IF- γ) were determined by using an ELISA kit and ELISA reader. This assay belongs to the quantitative description immunoassay technique. (IL-6, IL-8 & IF- γ) have been pre-coated onto a microplate. Standards and samples were automatically pipetted into the wells, and any interleukins (IL-6, IL-8 & IF- γ) present were pounded by the immobilized antibody. After washing the entire step, any unbounded substances, an enzyme-linked polyclonal antibody specific for interleukins (IL-6, IL-8 & IF- γ), were added to wells. The wash steps are very important to remove any unbounded antibody-enzyme reagent; a substrate solution was added to wells and changed colour in proportion to the number of interleukins (IL-6, IL-8 & IF- γ) bound in the initial step. The colour was stopped by stopping the solution, and the optical intensity of the colour was measured by Elisa's reader (Beyaert **et al.**, 1998).

4- Imaging technique:-

Fifty patients with a suspected virus (COVID-19) disease were examined using a multislice CT imaging modality (GE Bright speed eight detectors). Before scanning, all patients wore surgical masks during imaging. The scan parameters in machines were set as follows: tube voltage 120 (kV), slice interval 10 (mm), tube current 300 (mA), Beam Coll. (Det. Con) 8 x 2.5, Pitch1:1.675, FOV 350-400 (mm). The 2.5 (mm) or 1.25 (mm) thick images were reconstructed using a high-frequency algorithm. Acquisition slices thickness 10 (mm), scanning duration 9.07 (s), window width 600 (HU) and standard lung window level 1600 (HU). The mediastina window level is about 350 (HU), and the window width is about 50 (HU). The patient was rested in a comfortable supine position and held on their breath. The scanning area was specified to start at the lung apex and end at the posterior costophrenic angle. By the end of the scanning protocol, the patient's personal protective equipment was removed, and a disinfection protocol was applied for the equipment, examination room and personnel; the images were evaluated to ensure that the examination was successful and the high image quality was sufficient for diagnosis. In CT scanners, attenuation according to equations 1 and 2 is measured along various numbers of lines within a plane perpendicular to the long x-axis of all patients with the goal determination of reconstructing a map of the attenuation coefficients for this plane. The equation is given by:-

$$I = I_0 e^{-ax} \quad \text{eq (1)}$$

Where I_0 is the x-ray intensity without the object, I is the x-ray intensity, x is the length of the x-ray and a is the linear attenuation coefficient of the material for the x-ray highly energy. The attenuation of x-rays consequently can be described by the equation:-

$$I = I_0 e^{-\int a(x) dx} \quad \text{eq (2)}$$

5-Statistical methods:-

Data were analyzed through (SPSS). According to the research questions, Descriptive statistical techniques (Mean, Standard Deviation) and inferential (Independent sample t-test, one-way ANOVA). The experimental results in different groups are presented as mean \pm standard deviation (M + SD).

Experimental Results:-

1- Baseline Characteristics of the Virus (COVID-19) Patients in Egypt (Third wave): -

The common symptoms and signs were loss of smell or taste (77.26%), fever (90.23%), cough (55.2%), shortness of breath (56.33%), headache (88.23%), fatigue (41.32%), vomiting (9.23%), abdominal pain (8.54%), chest pain (9.55%) and diarrhoea (4.23%)

2- Effects of Virus (COVID-19) Patients in Egypt (Third wave) on Hematologic: -

Table 1 shows the mean and standard deviation white blood cell count and neutrophil counts (11.9 + 0.02, 12.8 + 0.09, 11.46 + 1.06, 12.66 + 1.44) for females and males, respectively. Significantly increased numbers of white blood cells and neutrophil counts ($P < 0.005$ and $P < 0.005$) in females and males, respectively. Table 1 shows the mean and standard deviation lymphocyte counts (8.000 + 7.5, 9.000 + 8.5), females and males, respectively. Significant increase in numbers of lymphocytes ($P < 0.002$ and $P < 0.005$). Table 1 shows the mean and standard deviation haemoglobin (7.9 + 0.525, 7.8 + 0.811) for females and males, respectively. Significant decrease of haemoglobin ($P < 0.001$ and $P < 0.005$). There was almost no difference between white blood cell count, neutrophil counts, lymphocyte and haemoglobin between the two groups in females and males.

Table (1): Hematologic Findings of Virus (COVID-19) Patients in Egypt (Third wave)

Parameters	WBC $\times 10^9/L$	Neutrophil count $\times 10^9$	Lymphocyte count $\times 10^9/\mu l$	Hemoglobin (12 -16 g/L)
Control group (GI) (mean + SD)	4.9 + 0.02	822 + 0.021	4.000 + 0.22	13 + 1.11
Females group (GII) (mean + SD)	11.9 + 0.02	11.46 + 1.06	8.000 + 7.5	7.9 + 0.525
T-Test	$P < 0.005$	$P < 0.005$	$P < 0.002$	$P < 0.001$
Males group (GIII) (mean + SD)	12.8 + 0.09	12.66 + 1.44	9.000 + 8.5	7.8 + 0.811
T-Test	$P < 0.005$	$P < 0.005$	$P < 0.005$	$P < 0.005$

(WBC), white blood cell. The different statistical parameters including (Mean + SD) with virus (COVID-19). C=Control M=male, F=female, SD=Standard Deviation: p value for Student t-test for comparing between the two studied group. Statistically significant at $p \leq 0.05$

3- Effects of Virus (COVID-19) Patients in Egypt (Third wave) on Liver & Kidney function tests:-

Table 2 shows the mean and standard deviation (AST), (ALT) (U/l), (U/l), urea (mg %) and creatinine (mg %) (72.9±14.13, 76.5±6.10, 89.95±8.90, 77.55±6.40, 77.55±8.97, 73.9±2.75, 5.27±0.93, 5.29±1.26) females and males respectively. Significant increased (ALT) (U/l), (AST), (U/l), ($P < 0.005$ and $P < 0.005$) in females and males, respectively. The data showed highly significant increased urea (mg %) ($P < 0.0001$ and $P < 0.0001$) and creatinine (mg %) ($P < 0.0001$ and $P < 0.0001$) in females and males, respectively. Table 2 shows the mean and standard deviation albumin (g/dl) (2.99 ± 0.32, 2.98 ± 0.32) for females and males, respectively. Significantly decreased albumin (g/dl) ($P < 0.001$ and $P < 0.001$). In these results no differences between the two groups in females and males in (ALT), (AST), urea, creatinine and albumin.

Table (2): Liver function tests & Kidney function tests Findings of virus (COVID-19) Patients in Egypt (Third wave)

Parameters Groups	(ALT) (U/l)	(AST) (U/l)	Albumin (g/dl)	Urea (mg %)	Creatinine (mg %)
C group (GI) (mean + SD)	18.7±4.40	19.35±4.27	4.18±0.48	39.5±6.79	0.50±0.26
F group (GII) (mean + SD)	72.9±14.13	89.95±8.90	2.99±0.32	77.5±8.97	5.27±0.93
T-Test	P < 0.005	P < 0.005	P < 0.001	P < 0.0001	P < 0.0001
M group (GIII) (mean + SD)	76.5±6.10	77.55±6.40	2.98±0.32	73.9±2.75	5.29±1.26
T-Test	P < 0.005	P < 0.005	P < 0.001	P < 0.0001	P < 0.0001

(ALT)Alanine aminotransferase, (AST).Glutamic-Oxaloacetic Transaminase .The different statistical parameters including (Mean + SD) with virus (COVID-19).C=Control F=female, M=male, S.D=Standard Deviation p value for Student t-test for comparing between the two studied group. Statistically significant at $p \leq 0.05$.

4- Effects of Virus (COVID-19) Patients in Egypt (Third wave) on Coagulation & Inflammatory testes: -

Table 3 shows the mean and standard deviation (D-dimer (< 200 (ng/ml)), Troponin (<0.03) (ng/ml), ESR 0-15 (mm/h), CRP (0-0.5 mg/dl), ferritin (21.81-274.66 (ng/ml)), and PCT ≥ 0.05 (nmol/l) (150.04 ± 99.9, 180.04 ± 89.7, 0.047 ± 0.17, 0.050 ± 0.19, 88 ± 1.1, 89 ± 1.2, 123.6 ± 244.06, 129.9 ± 250.17, 413.05 ± 254.6, 420.12 ± 259.9, 7 ± 0.11, 6 ± 0.10) females and males respectively. The data are significantly increased (D-dimer (< 200 (ng/ml)), In this results, no difference between the two groups (P < 0.001 and P < 0.001, P < 0.001 and P < 0.001, P < 0.005 and P < 0.005 , P < 0.005 P < 0.005, P < 0.001 P < 0.001 and P < 0.001 P < 0.001) females and males respectively.

Table (3): Coagulation &Inflammatory biomarkers tests findings of virus (COVID-19) patients in Egypt (Third wave)

Parameters Groups	Coagulation		Inflammatory biomarkers tests			
	D-dimer (<200) (ng/ml)	Troponin (<0.03) (ng/ml)	ESR 0-15 (mm/h)	CRP 0-0.5 (mg/dL)	Ferritin 21.81 -274.66 (ng/ml)	PCT ≥ 0.05 (nmol/L)
C group (GI) (mean + SD)	0.00	0.01±0.0	4±0.0	0.2±0.2	104± 1.02	0.01±0.02
F group (GII) (mean + SD)	150.04±99.9	0.047±0.17	88±1.1	123.6±244.06	413.05±254.6	7±0.11
T-Test	P < 0.001	P < 0.001	P < 0.005	P < 0.005	P < 0.001	P < 0.001
M group (GIII) (mean + SD)	180.04±89.7	0.050 ±0.19	89±1.2	129.9±250.17	420.12±259.9	6±0.10
T-Test	P < 0.001	P < 0.001	P < 0.005	P < 0.005	P < 0.001	P < 0.001

(ESR), Erythrocyte sedimentation rate. (CRP), C-reactive protein. (PCT) procalcitonin. The different statistical parameters including (Mean + SD) with virus (COVID-

19).C=Control F=female, M=male, S.D=Standard Deviation. p value for Student t-test for comparing between the two studied group. Statistically significant at $p \leq 0.05$.

5- Effects of Virus (COVID-19) Patients in Egypt (Third wave) on serum cytokine levels:

Table 4 showed the mean and standard deviation (Serum IL-6 level (Pg/ml), Serum IL-8 level (Pg/ml) and Serum IF- γ level (Pg/ml)), (6.99 ± 1.66 , 6.98 ± 1.85 , 103.35 ± 8.66 , 130.34 ± 8.58 , 36.01 ± 5.55 , 49.17 ± 6.47) respectively. Significant increased Serum IL-6 level (Pg/ml), Serum IL-8 level (Pg/ml) and Serum IF- γ level (Pg/ml), ($P < 0.001$ and $P < 0.001$, $P < 0.001$ and $P < 0.001$, $P < 0.001$ and $P < 0.001$) females and males respectively. These results show that there is no difference between the two groups in females and males (Serum IL-6 level (Pg/ml), Serum IL-8 level (Pg/ml) and Serum IF- γ level (Pg/ml)).

Table (4): IL-6 levels, IL-8 levels and IF- γ levels tests findings of virus (COVID-19) patients

Groups	Parameters	Serum IL-6 level (Pg/ml)	Serum IL-8 level (Pg/ml)	Serum IF- γ level (Pg/ml)
C group (GI) (mean + SD)		3.99±0.97	35.66±4.33	50.9±6.99
F group (GII) (mean + SD)		6.99±1.66	103.35±8.66	36.01±5.55
T-Test		P < 0.001	P < 0.001	P < 0.001
M group (GIII) (mean + SD)		6.98±1.85	130.34±8.58	49.17±6.47
T-Test		P < 0.001	P < 0.001	P < 0.001

(IL), interleukin; (IF), Interferon- γ the different statistical parameters including (Mean + SD) with COVID-19.C=Control F=female, M=male, S.D=Standard Deviation. p value for Student t-test for comparing between the two studied group. Statistically significant at $p \leq 0.05$.

5- Imaging findings: -

Fifty patients with a suspected virus (COVID-19) in Egypt (Third wave) showed signs of virus (COVID-19) pneumonia on chest imaging during examination and diagnosis. Fifteen (37.5%) patients were classified as early stage (Figs. 2). These cases frequently showed peripheral sub pleural ground glass opacities (GGO). Twenty-one (52.5%) patients were classified into mild to the moderate stage (Figs. 3 and 4). Four (10%) patients were classified into the aggressive stage (Figs. 5); patients in observation exhibited lesions in multiple lung segments and lobes, in patients commonly exhibited lesions in multiple lung segments and lobes with an increase in ground-glass opacity density accompanied by consolidation and cord-like shadows or grid-like.

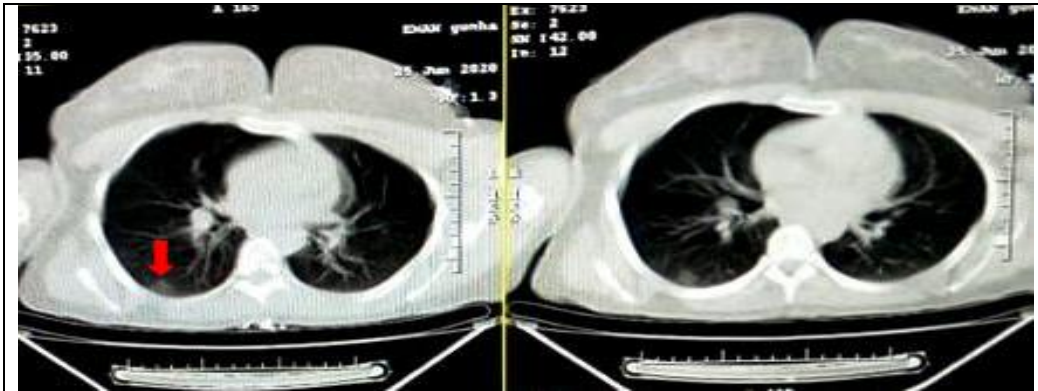


Fig.2. 25 year's old female has no notable signs but was in direct contact with infected patient with virus (COVID-19), images (A&B) axial chest CT image showed small patchy ground-glass opacities (arrow) located along vascular bundles in the subpleural region.

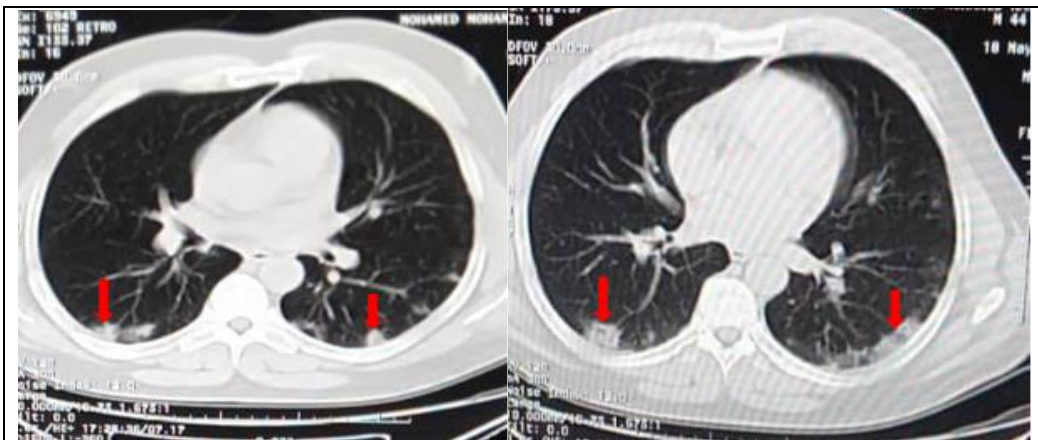


Fig.3. 44 years old male who has experienced cough, chest pain and mild fever for 3 days; image (A, B) Plain axial CT images (chest window) showed multiple bilateral subpleural ground glass opacities (GGO) (arrows).

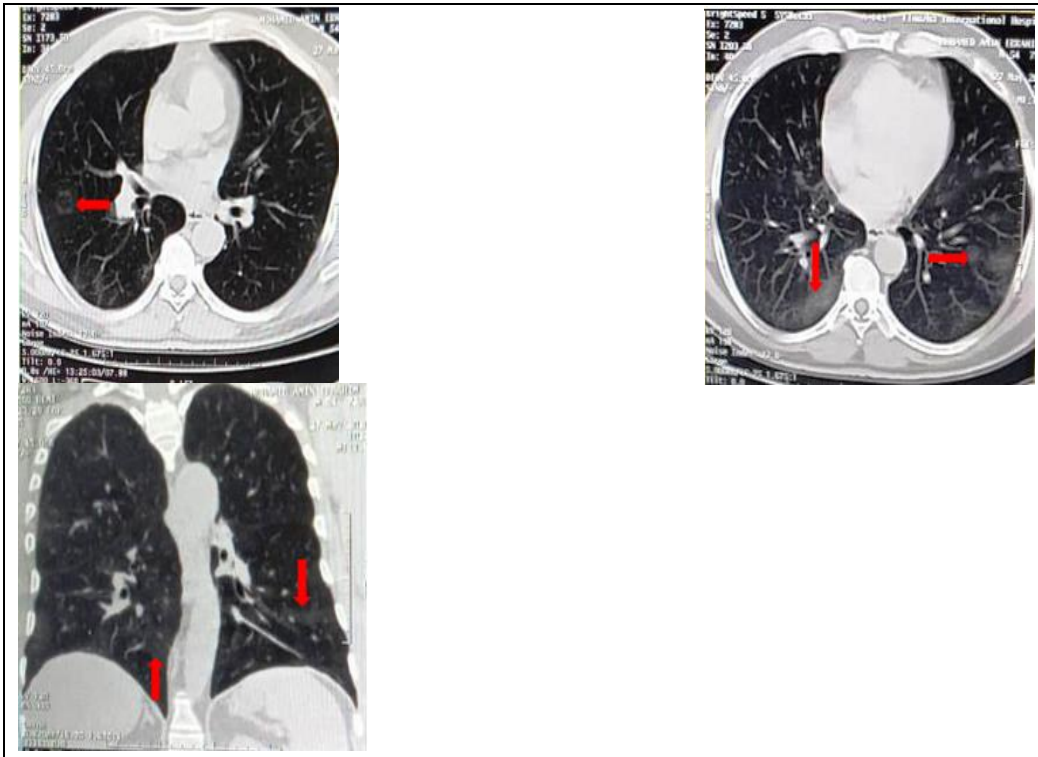


Fig.4. 54 years old male who reported fever, fatigue, and poor appetite for 5 days; image (A, B) Plain axial CT images (chest window) showed multiple bilateral subpleural ground glass opacities (GGO) (arrows), image (C) CT chest reconstructed image for the same patient with also multiple bilateral subpleural ground glass opacities (GGO) (arrows).

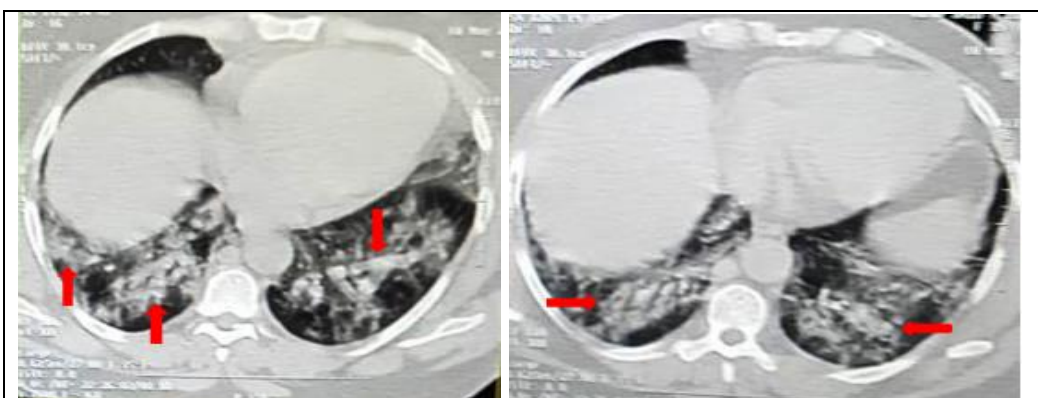


Fig.5. 35 years old female who has experienced cough, chest pain and sever fever for 7 days; (A&B) axial chest CT images showed bilateral lower lung interstitial thickening with multiple bilateral subpleural ground glass opacities (GGO) (arrows).

6- Virus (COVID-19) Patients in Egypt (Third wave) Findings: -

1. The main manifestations include common symptoms and signs of loss of taste, smell, fever, and cough, shortness of breath, headache, fatigue, vomiting, abdominal pain, chest pain and diarrhoea.
2. In the Virus (COVID-19) disease, peripheral WBC count is normal or increased, and the lymphocyte count is increased.
3. All patients have increased all testes (liver enzymes, Troponin, erythrocyte sedimentation rate (ESR) and C-reactive protein and procalcitonin). In all cases, D-dimer increases progressively decrease. Severe and critically ill patients often have increased inflammatory factors.
4. In the early stage, medical imaging shows multiple small patchy shadows and interstitial changes, more apparent in the peripheral zone of the lungs. As the disease progresses, imaging shows.
5. CT scan is done at different institutions at different times worldwide, necessitating that specific consideration be taken for the observed difference in the appearance of CT pulmonary findings according to the time of the scans.
6. In findings have suggested that it is the change in serum IL-6 level that is higher than the value in reflecting and monitoring the evolution of severe virus (COVID-19).
7. Transmission may be decreased indoors (stay home) with well-maintained heating and ventilation systems to maintain good flow air circulation and increase the use of outdoor air.
8. All persons and children must be wearing cloth masks, respirators, or other face coverings are control droplet transmission and keep social distancing.

Discussion:-

In this work, the patients with a virus (COVID-19) in Egypt (Third wave) spread from human to human, especially through the respiratory route after an infected person coughs, fatigues, talks, sings, sneezes, or breaths. The patients with the virus (COVID-19) in Egypt (Third wave) have a wide range of symptoms reported ranging from mild. The symptoms include repeated shaking and chills, headache, muscle highly pain, sore throat, and loss of sense of taste or smell. Symptoms typically appear within four days to fourteen days after exposure **to the virus** (COVID-19). On the other hand, the significant increase in peripheral WBC count is normal or increased, but the lymphocyte count is increased. CRP is a type of very important protein, so CRP is produced by the liver and increases in case of inflammation (Mortensen **et al.**, 2001; Marnell **et al.**, 2005). CRP level is highly valued in bacterial or viral infections. This work showed an increase in CRP levels in case virus (COVID-19) in Egypt (Third wave), after infected with virus (COVID-19) in Egypt (Third wave) due to the results high increase in (CRP, ESR, ALT, AST, lactate dehydrogenase, ferritin levels) may include data in this work

agreement with other studies (Coster **et al.**, 2020). In this work, a significant increase in (ALT) (U/l), (and AST), (U/l) but a highly significant increase in urea (mg %) and Creatinine (mg %). The results from virus (COVID-19) patients in Egypt (Third wave) showed significantly decreased albumin and no difference between the two groups in females and males lymphocyte and haemoglobin; this work agreement with other studies (Guan **et al.**, 2019; Wang **et al.** 2019& 2020, Wu **et al.**, 2020 and Ai **et al.**, 2020)

The results from virus (COVID-19) patients in Egypt (Third wave) significantly increased (ESR 0-15) (mm/h), CRP (0-0.5 mg/dl), Serum ferritin (21.81-274.66ng/ml), PCT \geq 0.05 (nmol/l), D-dimer ($<$ 200 (ng/ml)), Troponin ($<$ 0.03) (ng/ml), serum IL-6 level (Pg/ml), serum IL-8 level (Pg/ml) and serum IF- γ level (Pg/ml). Increased D-dimer and lymphopenia have been proposed to the serum cytokine storm as it remains to be one of the leading causes of mortality and morbidity in the virus (COVID-19). These results agree with (Wu **et al.**, 2019 & 2020) (Bernheim **et al.**, 2020) (Chen **et al.**, 2019 & 2020) (Wang **et al.**, 2020).

On the other hand, the results from virus (COVID-19) patients in Egypt (Third wave) serum IL-6 levels were related to clinical and laboratory examination indicating a systemic inflammatory response, for example, taste, smell, body temperature, ESR, CRP, and ferritin. Serum IL-6 levels were related to more progressed chest CT assessment. Some virus (COVID-19) patients in Egypt (Third wave) have needed ICU and treatment immune supplements, which may be due to the results of more severe lung damage. In this work, CRP, ESR, ferritin, and IL-6 decreased significantly after recovery, and all patients stayed at home for about three months. This work related to disease progression by exacerbating pulmonary lesions on chest CT scans and high serum IL-6 levels in females or males. This results in agreement with (Emery **et al.**, 2008; Norelli **et al.**, 2018). On the other hand, the promising therapeutic effect of tocilizumab and the enhancement of the immune system have recently been reported in treating severe virus (COVID-19) patients (Michot **et al.**, 2020; Zhang **et al.**, 2020). The numerous mechanisms that may cause the elevation of CRP and increased IL-6-related signalling are well-established as a driver of increased CRP (Moore & June, 2020). IL-8 has also been shown to up-regulate in the lung samples of SARS-CoV-infected macaques (de Lang **et al.**, 2007).

Characteristic medical imaging features on chest radiographs and computed tomography CT scans helpful and guide to diagnosing virus (COVID-19) patients in Egypt (Third wave) typically demonstrate bilateral air-space consolidation, though virus (COVID-19) patients may have unremarkable chest radiographs early in the disease (Guan **et al.**, 2019& 2020; Lei **et al.**, 2019& 2020). Chest CT images from patients with a virus (COVID-19) typically demonstrate bilateral, multilobar ground-glass opacities with a peripheral, asymmetric, and posterior distribution are common in early infection (Chen **et al.**, 2019 & 2020 ;Xu **et al.**, 2019 & 2020;To **et al.**, 2020;Shi **et al.**, 2019 & 2020 ;Inciardi **et al.**, 2019 & 2020). Because this chest CT medical imaging

pattern is non-specific and overlaps with other infections, CT imaging is highly medical imaging for virus (COVID-19) patients may be low and dependent upon radiographic interpretation. These results agree with (Wang **et al.**, 2020) (Li Y, Xia L **et al.**, 2020); (Emami A **et al.**, 2021).

In February 2021, the scientists discovered a number of vaccines, for example (the Oxford–AstraZeneca vaccine, the Moderna vaccine and the Bio N Tech vaccine Pfizer), conventional inactivated vaccines (BBIBP-CorV, Covaxin, and Corona Vac), viral vector vaccines (Sputnik V, Convidicea, and one peptide vaccine (EpiVac Corona and the Johnson vaccine) (Vaccine Centre, Tropical Medicine, 2021). Egypt's virus (COVID-19) co-existence plan, so the Egyptian new government implemented a nationwide lockdown and safe social distancing with others (not less than 1.5 meters). measures to control the spread of the virus (COVID-19) starting in March 2020 till now. Amid virus (the COVID-19) pandemic, no work in cinemas, theatres, restaurants, cafes, universities, schools, nurseries, sports clubs, gyms, and wedding and funeral halls. In Egypt, the Ministry of Health and Population has played a role in overseeing the government's ongoing health response, releasing daily total confirmed cases, recoveries, and death rates across the country.

Conclusions: -

virus (COVID-19) patients in Egypt (Third wave) with respiratory distress, we recommend clinicians closely monitor WBC count, Neutrophil count, lymphocyte count, IL-6, IL-8, IF- γ , ferritin, ESR, and CRP as markers for potential progression to critical illness. IL-6, IL-8 and IF- γ are increased in patients with the virus (COVID-19). **General regulations** and safety precautions clean and sanitize any surfaces continuously. All humans use disposable tissues when coughing and sneezing and stay home.

Acknowledgements:-

We thank Dr. Nashwa Abbass from applied Medical Sciences for supporting this study.

References: -

- Addai-Mensah O, Annani-Akollor ME, Fondjo LA, Anto EO, Gyamfi D, Sallah L, Agama D, Djabatey R & Owiredu E-W (2019). High-sensitivity C-reactive protein: a potential ancillary biomarker for malaria diagnosis and morbidity. *Disease Markers* 2019 1408031. (<https://doi.org/10.1155/2019/1408031>).
- Ai T, Yang Z, Hou H, **et al** (2020). Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. *Radiology*: 200642.
- Bergmeyer, H.; Schreiber, P. and Wahlefeld, A. (1978). Optimization of methods for aspartate aminotransferase and alanine aminotransferase. *Clin. Chem.* 24 (1): pp 58-73.
- Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N **et al** (2020) Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. *Radiology*. 200463

- Beyaert R. and Fiers W. (1998). Tumor Necrosis Factor and Lymphotoxin. In Cytokines. A. R. M.-S. a. R. Thorpe, eds. Academic Press, San Diego, pp 335-360.
- Chen N, Zhou M, Dong X, **et al.** (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet* 395: pp 507-13.
- Chen Y, Rubin P, Williams J, Hernady E, Smudzin T, Okunieff P (2001) Circulating IL-6 as a predictor of radiation pneumonitis. **Int J Radiat Oncol Biol Phys** 49: pp 641–648 Crossref PubMed Web of Science@Google Schola.
- Corman, V.M., Landt, O., Kaiser, M., Molenkamp, R., Meijer, A., Chu, D.K., Bleicker, T., Bruñink, S., Schneider, J., Schmidt, M.L., et al. (2019). Detection of novel coronavirus (2019-nCoV) by real-time RT-PCR. *Euro Surveill.* 2020. 25 <https://doi.org/10.2807/1560-7917.ES.2020.25.3.2000045>.
- Coster D, Wasserman A, Fisher E, **et al.** (2020) .Using the kinetics of C-reactive protein response to improve the differential diagnosis between acute bacterial and viral infections. *Infection*; 48: pp 241–8.
- "COVID-19 vaccine development pipeline (Refresh URL to update)". Vaccine Centre, London School of Hygiene and Tropical Medicine. 18 January 2021. Retrieved 18 January 2021.
- de Brito RC, Lucena-Silva N, Torres LC, Luna CF, Correia JB, da Silva GA (2016) .The balance between the serum levels of IL-6 and IL-10 cytokines discriminates mild and severe acute pneumonia. *BMC Pulm Med* 16: 170 Crossref PubMed Web of Science @Google Scholar.
- De Lang, A., Baas, T., Teal, T., Leijten, L.M., Rain, B., Osterhaus, A.D., Haagmans, B.L., Katze, M.G., (2007). Functional genomics highlights differential induction of antiviral pathways in the lungs of SARS-CoV-infected macaques. *PLoS Pathog.* 3 (8), e112
- Emery P, Keystone E, Tony HP, Cantagrel A, van Vollenhoven R, Sanchez A, Alecock E, Lee J, Kremer J (2008) .IL-6 receptor inhibition with tocilizumab improves treatment outcomes in patients with rheumatoid arthritis refractory to anti-tumour necrosis factor biologicals: results from a 24-week multicentre randomised placebo-controlled trial. *Ann Rheum Dis* 67: pp1516–1523 Crossref CAS PubMed Web of Science@Google Scholar.
- Guan WJ, Ni ZY, Hu Y, **et al.** (2020). Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*; 382:1708-20.
- Hall WA, Nickleach DC, Master VA, Prabhu RS, Rossi PJ, Godette K, Cooper S & Jani AB (2013). The association between C-reactive protein (CRP) level and biochemical failure-free survival in patients after radiation therapy for nonmetastatic adenocarcinoma of the prostate. *Cancer* 119 3272–3279. (<https://doi.org/10.1002/cncr.28185>).
- Hernán J. Zavalaga-Zegarra, Juan J. Palomino-Gutierrez, Juan R. Ulloque-Badaracco, Melany D. Mosquera-Rojas, Enrique A. Hernandez-Bustamante, Esteban A. Alarcon-Braga, Vicente A. Benites-Zapata, Percy Herrera-Añazco and Adrian V. Hernandez (2022). C-Reactive Protein-to-Albumin Ratio and Clinical Outcomes in COVID-19 Patients: A Systematic Review and Meta-Analysis. *Trop. Med. Infect. Dis.*, 7, 186. <https://doi.org/10.3390/tropicalmed7080186>.
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y **et al** (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet (London, England)* 395(10223); pp.497-506.
- Iivanainen S, Ahvonen J, Knuutila A, Tiainen S & Koivunen JP (2019). Increased CRP levels indicate poor progression-free and overall survival on cancer patients treated with PD-1 inhibitors. *Esmo Open* 4 e000531. (<https://doi.org/10.1136/esmoopen-2019-000531>).
- Inciardi RM, Lupi L, Zaccone G, **et al.** (2020). Cardiac Involvement in a Patient with Coronavirus Disease 2019 (COVID-19). *JAMA Cardiol.*

- Ksiazek, T.G., Erdman, D., Goldsmoth, C.S., Zaki, S.R., Peret, T., Emery, S., Tong, S., Urbani, C., Comer, J.A., Lim, W., Rollin, P.E., Dowell, S.F., Ling, A., Humphrey, C.D., Shieh, W., Guarner, J., Paddock, C.D., Rota, P., Fields, B., DeRisi, J., Yang, J., Cox, N., Hughes, J.M., LeDuc, J.W., Bellini, W.J., Anderson, L.J., SARS Working Group, (2003). A novel coronavirus associated with severe acute respiratory syndrome. *N. Engl. J. Med.* 348, pp 1953–1966.
- Lei J, Li J, Li X, Qi X. (2020). CT Imaging of the 2019 Novel Coronavirus (2019-nCoV) Pneumonia. *Radiology* pp 295:18.
- Li Y, Xia L (2020). "Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management". *AJR. American Journal of Roentgenology.* 214 (6): 1280–1286. Doi:10.2214/AJR.20.22954. PMID 32130038. S2CID 212416282.
- Marnell L, Mold C, Du Clos TW. (2005). C-reactive protein: ligands, receptors and role in inflammation. *Clin Immunol*; 117: pp 104–11.
- Michot JM, Albiges L, Chaput N, Saada V, Pommeret F, Griscelli F, Balleyguier C, Besse B, Marabelle A, Netzer F **et al** (2020). Tocilizumab, an anti-IL6 receptor antibody, to treat Covid-19-related respiratory failure: a case report. *Ann Oncol* <https://doi.org/10.1016/j.annonc.2020.03.300> Crossref PubMed Web of Science@Google Scholar.
- Moore JB & June CH (2020). Cytokine release syndrome in severe COVID19. *Science* 368 473. (<https://doi.org/10.1126/science.abb8925>).
- Mortensen RF. (2001). C-reactive protein, inflammation, and innate immunity. *Immunol Res*; 24: pp 163–76.
- Norelli M, Camisa B, Barbiera G, Falcone L, Purevdorj A, Genua M, Sanvito F, Ponzoni M, Doglioni C, Cristofori P **et al** (2018). Monocyte-derived IL-1 and IL-6 are differentially required for cytokine-release syndrome and neurotoxicity due to CAR T cells. *Nat Med* 24: pp 739–748 Crossref CAS PubMed Web of Science@Google Scholar.
- Pan F, Ye T, Sun P, Gui S, Liang B, Li L **et al** (2020). Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia. *Radiology*.200370.
- Pan Y, Guan H, Zhou S, Wang Y, Li Q, Zhu T **et al** (2020). Initial CT findings and temporal changes in patients with the novel coronavirus pneumonia (2019-nCoV): a study of 63 patients in Wuhan, China. *Eur Radiol*.
- Emami A, Javanmardi F, Akbari A, Asadi-Pooya AA. (2021): COVID-19 in patients with Down syndrome. *Neurol Sci.* Feb 1
- Shi H, Han X, Zheng C. (2020). Evolution of CT Manifestations in a Patient Recovered from 2019 Novel Coronavirus (2019-nCoV) Pneumonia in Wuhan, China. *Radiology*; pp 295:20.
- Siemes C, Visser LE, Coebergh JW, Splinter TA, Witteman JC, Uitterlinden AG, Hofman A, Pols HA & Stricker BH (2006). C-reactive protein levels, variation in the C-reactive protein gene, and cancer risk: the Rotterdam study. *Journal of Clinical Oncology* 24 5216–5222. (<https://doi.org/10.1200/JCO.2006.07.1381>).
- Tanaka T, Narazaki M, Kishimoto T (2014) IL-6 in inflammation, immunity, and disease. *Cold Spring Harb Perspect Biol* 6: a016295 Crossref PubMed Web of Science@Google Scholar.
- To KK, Tsang OT, Leung WS, **et al.** (2020). Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. *Lancet Infect Dis*.

- Vasileva D & Badawi A (2019). C-reactive protein as a biomarker of severe H1N1 influenza. *Inflammation Research* 68 pp 39–46. (<https://doi.org/10.1007/s00011-018-1188-x>).
- Wang D, Hu B, Hu C, **et al.** (2019). Clinical Characteristics of 138 Hospitalized Patients With Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* 2020.
- Wang Y, Dong C, Hu Y, **et al.** (2020). Temporal Changes of CT Findings in 90 Patients with COVID-19 Pneumonia: A Longitudinal Study. *Radiology*: 200843.
- Wang, C., Horby, P.W., Hayden, F.G., and Gao, G.F. (2020). A novel coronavirus outbreak of global health concern. *Lancet*. 395, pp 470–473.
- Weber JS, Tang H, Hippeli L, Qian M, Wind-Rotolo M, Larkin JMG, Wolchok JD, Sznol M, Robert C, Woods DM, **et al.** (2019). Serum IL-6 and CRP as prognostic factors in melanoma patients receiving single agent and combination checkpoint inhibition. *Journal of Clinical Oncology* 37 100–100. (https://doi.org/10.1200/JCO.2019.37.15_suppl.100).
- Wei J, Xu H, Xiong J, Shen Q, Fan B, Ye C **et al.** (2019). Novel Coronavirus (COVID-19) Pneumonia: Serial Computed Tomography Findings. *Korean J Radiol*, 2020; 21(4): pp 501–504.
- WHO, (2003). Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. Available: <http://www.who.int>.
- Wu C, Chen X, Cai Y, **et al.** (2020) .Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients With Coronavirus Disease 2019 Pneumonia in Wuhan, China. *JAMA Intern Med* 2020.
- Wu Z, McGoogan JM. (2020). Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020.
- Xu X, Yu C, Qu J, **et al.** (2020). Imaging and clinical features of patients with 2019 novel coronavirus SARS-CoV-2. *Eur J Nucl Med Mol Imaging*; 47: pp 1275-80.
- Yuan M, Yin W, Tao Z, Tan W, Hu Y (2020) .Association of radiologic findings with mortality of patients infected with 2019 novel coronavirus in Wuhan, China. *PLoS One* 15(3):e0230548.
- Zhang X, Song K, Tong F, Fei M, Guo H, Lu Z, Wang J, Zheng C (2020). First case of COVID-19 in a patient with multiple myeloma successfully treated with tocilizumab. *Blood Adv* 4: 1307–1310 Crossref PubMed Web of Science @Google Scholar.