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ORIGINAL ARTICLE

Assessment of High-resolution Computed Tomography Thorax Volumetric Indices in Covid-19 Patients and Correlation with Biochemical Markers

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Abstract

Background: Years after SARS recovery, residual pulmonary abnormalities may still exist. This raises the question of whether or not Covid-19 could have comparable late consequences. Structural changes in the Lungs after recovery can be better visualized using CT-Thorax. **Objectives:** To study the Covid CT changes during hospitalization and after four months follow-up of infection, and to correlate with the volumetric HRCT thorax indices and Biochemical parameters. **Materials and Methods:** This is a hospital-based Cross-sectional study, with a follow-up among 100 Hospitalized clinically moderate to severe Covid-19 patients who recovered after four months. **Results:**The biochemical markers such as d-Dimer and C-Reactive Protein (CRP) were significantly reduced. The values of NL (L) and NL (%) had a significant negative correlation with d-Dimer and C-Reactive Protein (CRP). The individuals' average ages in years, which ranged from 24 to 80, were 48.56 ± 13.87. **Conclusion:** Biochemical indicators, including d-Dimer and CRP, were greatly decreased. The NL (L) and NL% values exhibited a strong negative connection with d-Dimer and C-reactive protein (CRP) both during and after Covid. Hence the different CT indices (NL, NL%) can be used along with Biochemical parameters (CRP and d-Dimer) for structural and functional recovery in Covid-19 patients.

Keywords

COVID-19, HRCT, CT Indices, Bio-chemical Parameters, CRP, D-dimer.

Introduction

The first COVID-19 infections were reported in Wuhan, China, in December 2019. There will have been an impact on 220 nations due to the coronavirus' rapid spread. The USA, Brazil, Mexico, and India are the most affected countries (equalling more than 1.3 million fatalities and more than 65 million illnesses).[1,2] The novel coronavirus SARS-CoV-2 that causes COVID-19 sickness is genetically similar to existing strains of the coronavirus family, including the severe acute respiratory syndrome coronavirus (SARS-CoV-2) and the Middle East respiratory syndrome coronavirus (MERS-CoV).[3,4] The lung is the organ that is most frequently affected by COVID-19; as a result, the lung may consolidate, hyaline membranes may form, capillaries may get injured and

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bleed, and extensive alveolar epithelial deterioration may occur. A distinguishing feature of Covid-19 is the severe destruction of alveolar epithelial and endothelial cells, followed by fibro growth that causes lung fibrosis and pulmonary hypertension. The aforementioned disorders cause acute respiratory distress syndrome and pulmonary affection. These results raise concerns regarding how patients should be evaluated for lung damage before discharge.[5]

High-resolution computed tomography (HRCT) has shown to be particularly useful for screening, early illness identification, and disease severity grading. Bilateral peripheral ground-glass patches or more obvious consolidations at basal lung segments were the most common CT imaging findings for COVID-19. Various stages of the sickness' radiological characteristics have been examined in another research. However, it's still essential to review radiological results after a patient leaves the hospital and while they're recovering.[6]

Activation of endothelial cells and macrophages, inhibition of neutrophil apoptosis and expression of endothelial NO synthase, platelet aggregation, accumulation of lipid and thrombosis, complement activation, fibrosis, and upregulation of proinflammatory cytokine expression are all pathophysiological stages of acute or chronic inflammatory diseases.[7] There is a significant prevalence of both macrovascular and microvascular thrombotic events in Covid-19 cases. High levels of D-dimer, a by-product of protein breakdown during coagulation, predict death.[8] The epidemiological reports' descriptions of the anomalies in chest computed tomography (CT) results can be analyzed with those of the biochemical parameter tests. The purpose of this study is to compare the Covid CT changes throughout hospitalization and four months following infection with the findings of biochemical parameter testing and the infection severity.

Materials and Methods

The hospital-basedcross-sectional study enrolled 100 post covid recovered patients with clinically moderate to severe infection during hospitalization and CT scores of more than 8/25.[9] The study objective is to calculate the volume of each anatomic lung lobe reconstructed using 3D CT imaging from MDCT images and SYNAPSE 3D Lung Airway Analysis Application Version 6.1 Fujifilm medical system software (*Fig 1*). We compare these results with biochemical parameters during hospitalization and after four months of follow-up. HRCT and simultaneously Biochemical parameters of all the patients were done at admission and reporting for follow-up after four months post-Covid. All clinically moderate to severe Covid-19 patients hospitalized with Covid-19 and recovered were included in our study. Covid patients with other co-morbidities and post-Covid patients <15 years and >85 years were excluded. Institutional Ethical Committee approval of the study was obtained before the start of the study, and informed written consent was also obtained.

Statistical Analysis

The numerical data, such as age, biochemical parameters, etc., are expressed in mean, SD, median, and mode according to descriptive statistics. Frequencies and percentages represent gender, age, CT chest results, and other categorical data. When necessary, pie charts and bar graphs are employed. Data was stored in a Microsoft Excel spreadsheet and analyzed with SPSS version 16. P-values of 0.05 or less were regarded as statistically significant.

Results

The hospital-based cross-sectional study enrolled 100 cases of post-Covid recovered patients with clinically moderate to severe infection during hospitalization.The mean age (years) among the subjects was 48.56 ± 13.87 years ranging from 24 to 80 years. Among the subjects, 75 (75%) had males, and 25 (25%) had females. The mean initial CT score among the subjects was 11.5 ± 3.99, ranging from 8 to 23. Among the subjects, 26 (26%) had Complete Resolution 4 months post-Covid. The mean WL (L) during Covid was 3.04, which is higher than the mean WL (L) 4 months post-Covid, which was 3.02, and the difference between WL (L) during Covid and WL (L) 4 months post-Covid was not statistically significant (P=0.268). The mean NL (L) during Covid was 2.36, which is lower than the mean NL (L) 4 months post-Covid, which was 2.61, and the difference between NL (L) during Covid and NL (L) 4 months post-Covid was statistically significant (P=0.001). The mean NL% during Covid was 75.57, which is lower than the mean NL% 4 months post-Covid which was 85.76, and the difference between NL% during Covid and NL% 4 months post-Covid was statistically significant (P=0.001).

The mean d-Dimer during Covid was 0.73, which has reduced by 0.32 four months post-Covid, which was 0.41, and the difference between d-Dimer during Covid andfour months post-Covid was statistically significant (*Table 1*). The mean C-Reactive Protein (CRP) during Covid was 3.16, which has reduced by 2.37 four months post-Covid, which was 0.79, and the difference between CRP during Covid and four months post-Covid was statistically

Table 1: D-Dimer and C-Reactive Protein (CRP), (n=100)

Group	Mean ± SD	Mean Diff.	p-value
d-Dimer during COVID	0.73±0.71	0.32	0.001
d-Dimer four months post-COVID	0.41±0.43		
C-Reactive Protein (CRP) during COVID	3.16±2.38	2.37	
C-Reactive Protein (CRP) 4 months post COVID	0.79±0.93		

Table 2: Correlation of Volumetric HRCT Indices with Bio-chemical Parameters during Covid and four Months post-Covid

Volumetric HRCT indices	d-Dimer	C-Reactive Protein (CRP)
During Covid WL (L)		
Correlation coefficient	-0.181	-0.162
P	0.071	0.107
Post-Covid WL (L)		
Correlation coefficient	-0.152	-0.183
P	0.130	0.069
During Covid NL (L)		
Correlation coefficient	-0.341	-0.387
P	0.001	0.001
Post-Covid NL (L)		
Correlation coefficient	-0.370	-0.463
P	0.001	0.001
During Covid NL (%)		
Correlation coefficient	-0.254	-0.367
P	0.011	0.001
Post-Covid NL (%)		
Correlation coefficient	-0.503	-0.626
P	0.001	0.001

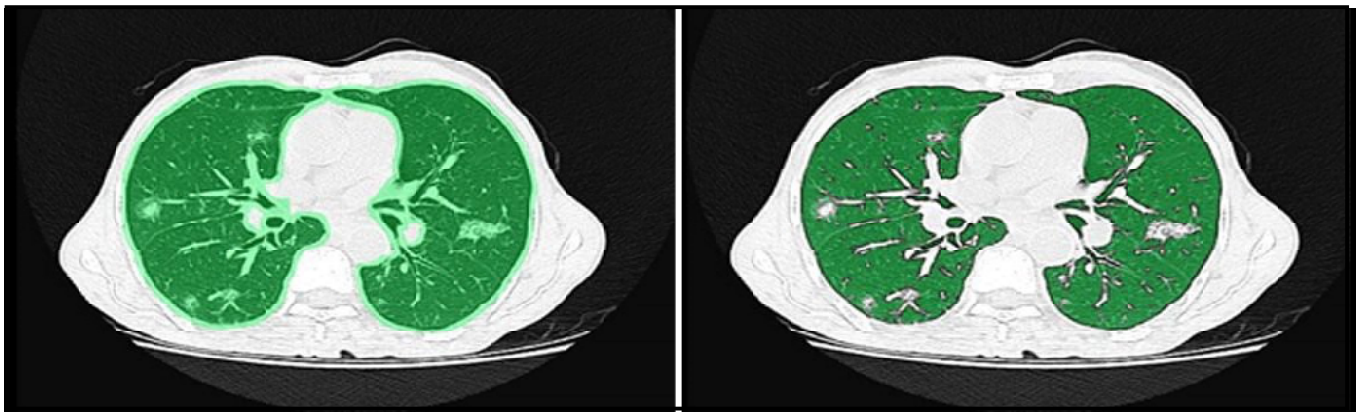

Fig 1: Volumetric HRCT thorax image Axial section showing whole lung volume – 3.94(L) (Includes Pathology) and normal lung volume 2.60(L) (excludes pathology).

significant (*Table 1)*.The NL (L) and NL (%) significantly negatively correlated with d-Dimer and CRP during Covid. The WL (L) correlations with Biochemical parameters were not statistically significant during Covid.NL% has a negative correlation with d-Dimer with a correlation coefficient of -0.25. d-Dimer decreases by -0.01 times for each unit increase in NL% (*Table 2*). The correlation between d-Dimer and NL% was statistically significant during Covid.NL% negatively correlates with CRP with a correlation coefficient of -0.37. CRP decreases by -0.05 times for each unit increase in NL%. The correlation between CRP and NL% was statistically significant.

The NL (L) and NL (%) significantly negatively correlated with d-Dimer and CRPfour months post-Covid. The WL (L) correlations with Biochemical parameters were not statistically significantpost-Covid.NL% has a negative correlation with d-Dimer with a correlation coefficient of -0.5. d-Dimer decreases by -0.02 times for each unit increase in NL%. The correlation between d-Dimer and NL% was statistically significant.NL% negatively correlates with CRP, with a correlation coefficient of -0.63. C-Reactive Protein decreases by -0.05 times for each unit increase in NL%. The correlation between CRP and NL% was statistically significant post-Covid (*Table 2)*.

Discussion

Age is an important parameter in determining the severity, prognosis, and duration of Covid illness. In this study, the mean Age (years) among the subjects was 48.56±13.87, ranging from 24 to 80 years. Age, extended hospital stays, acute respiratory distress syndrome, tachycardia, non-invasive mechanical ventilation, and a higher baseline chest CT score were all associated with lung abnormalities.[10] Gender plays an important role in CT involvement and the prognosis of Covid.[11] In this study,75% had Males, and 25% had Females. The higher male prevalence in this study may be due to increased prevalence, severity, and follow-up rates among the males.In this study, the mean d-Dimer during Covid was 0.73, significantly reduced in 4 months post-Covid, which was 0.41.In this study, the mean CRP during Covid was 3.16, significantly reduced in 4 months post-Covid, 0.79. Age, duration of hospital stays, invasive ventilation, and higher blood C-reactive protein, fibrinogen, urea, and creatinine levels upon entry were all linked to CT abnormalities.[12, 13]

In this study, both during the Covid and post-Covid, the NL (L) and NL (%) had a significant negative correlation with d-Dimer and C-Reactive Protein (CRP). The WL (L) correlations with Bio-chemical Parameters were not statistically significant. A study results researcher found that D-dimer is significantly associated with Covid-19 mortality and the need for anticoagulation therapy.[14] In this study, during the Covid and Post-Covid, the Volumetric HRCT indices NL (L) and NL (%) had a significant negative correlation with d-Dimer and CRP. The WL (L) correlations with Bio-chemical Parameters were not statistically significant. Gameilet al., studying the post-Covid clinical and biochemical changes, observed that Serum lipase, amylase, and albuminuria were all substantially elevated, as were erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), D-dimer, Alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl trans-peptidase (GGT), and alkaline phosphatase (ALP). In Covid-19 survivors, serum albumin levels dropped, although these numbers were unrelated to the CT indices.[15]

Conclusion

The mean NL (L) and NL% during Covid were significantly lower than the mean values four months post-Covid. The biochemical markers such as d-Dimer and C-reactive protein were significantly reduced after four months of follow-up. During Covid and post-Covid, NL (L) and NL (%) values had a significant negative correlation with d-Dimer and C-reactive protein. Hence the different CT indices (NL, NL%) can be used along with the biochemical parameters like CRP and D-dimer for both structural and functional recovery of Covid-19 patients.

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Conflicts of Interest

There are no conflicts of interest.

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