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CORRELATION OF CHEST X-RAYS WITH LAB PARAMETERS IN COVID-19

Dr. Geetika P, Dr. Mary Varunya J, Dr. Suresh A, Dr. Sudhanva N, Dr. Mummadi Swathi, Dr. Kaviya V

Department of Radiodiagnosis & imaging, Vydehi institute of medical sciences & research Centre, Whitefield, Bangalore

BACKGROUND

Severe acute respiratory syndrome coronavirus 2 is an RNA virus belonging to the Coronaviridae family [1]. They are enveloped viruses with positive sense single stranded RNA genome and a nucleocapsid of helical symmetry. They cause respiratory infections, ranging from common cold to pneumonia to severe acute respiratory syndrome. This novel pulmonary infection, also called coronavirus disease 2019(COVID 19) has caused an outbreak in the entire world with India being one of the most affected. Throat and nasal swab -RT PCR has been the gold standard for the diagnosis of COVID 19 [2].

INTRODUCTION:

Chest CT has been widely used to assess the extent of lung involvement and the severity of the disease [1]. However it is not routinely used to assess the progression of COVID-19 because of the amount of radiation involved, constraints in the transport of very sick patients and the risk of contaminating the CT room. The ease of doing an X-ray bedside, lower radiation and repeatability make it the modality of choice for assessment of disease progression. Laboratory parameters like C - reactive protein, D- dimer [3], ferritin and leukocyte count can also be used to assess the progression of the disease by evaluating the improvement or deterioration of the values [4]. There have been a few studies correlating chest x-rays and lab parameters in the progression of COVID 19. The purpose of this study is to determine the correlation between chest x-ray and lab parameters in assessing the progression of COVID 19.

OBJECTIVES

To determine if there is an association between chest x-ray findings and lab parameters (C-Reactive protein, D- dimer, ferritin and leukocyte count) in assessing the progression of COVID 19.

MATERIALS AND METHODS

This study is a retrospective observational study of RT PCR positive patients for COVID 19, who were hospitalized in VYDEHI INSTITUTE OF MEDICAL SCIENCES AND RESEARCH CENTRE, BANGALORE and underwent routine Chest x-ray and laboratory investigations for further management.

Duration of study – September 2020- September 2021

- **Sample size formula:** $n = \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{C} \right)^2$

Significant Sample size = 91. The study was performed on a total sample of 93 patients**.**

Type of study- Cross sectional study

Inclusion Criteria:

All patients who tested RT-PCR positive for COVID-19 and were hospitalized in Vydehi institute of medical sciences and research centre and underwent routine Chest x-ray and laboratory investigations for further management.

Exclusion Criteria:

Patients who do not have the corresponding laboratory investigations.

Methods of Data Collection:

The X-ray images of patients who tested RT-PCR positive for COVID 19 were collected from the picture archiving and communication system. The lab parameters (C- Reactive protein, D- dimer, ferritin and leukocyte count) of the patients were collected from medical records after obtaining due permission from the superintendent. The X-ray image and lab parameters were collected at two different time frames after hospital admission. The X-ray and lab parameters of a single time frame were collected within a span of 24 hours.

Two scoring systems were used to assess the severity of the infection on chest x-ray.

First scoring system [SCORE A] [1]:

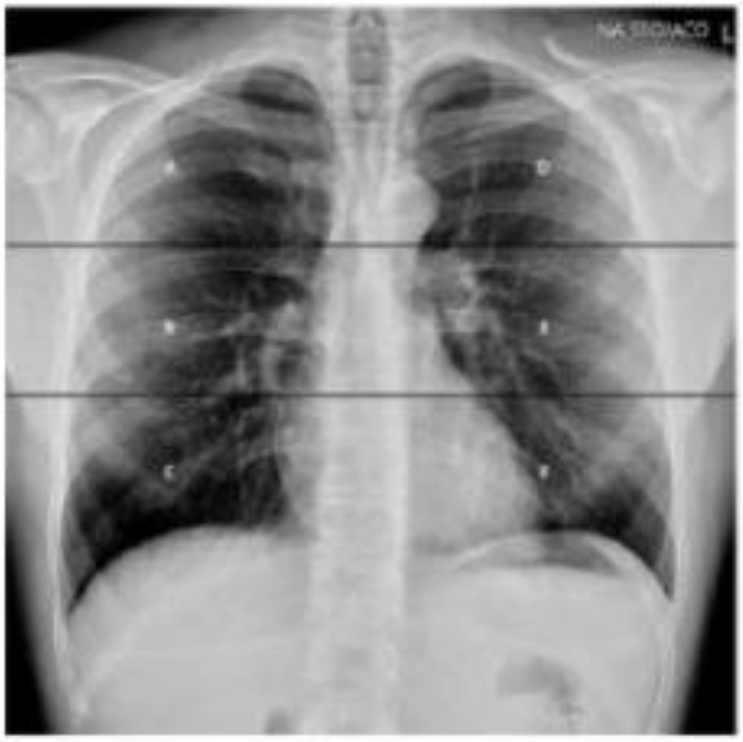
Brixia CXR scoring system includes two steps of imaging analysis. The first step is to divide each lung into three zones on frontal chest projection (PA or AP), marked as letters A, B, and C for the right lung and D, E, and F for the left lung.

The letters divide lungs into three levels:

Upper level (A and D) – above the inferior wall of the aortic arch

Middle level (B and E) – below the inferior wall of the aortic arch and above the inferior wall of the right inferior pulmonary vein (the hilar structures)

Lower level (C and F) – below the inferior wall of the right inferior pulmonary vein (the lung bases).



A score (from 0 to 3 points) to each zone based on the detected lung abnormalities:

Score	
0	no lung abnormalities
1	interstitial infiltrates
2	interstitial and alveolar infiltrates(interstitial predominance)
3	interstitial and alveolar infiltrates (alveolar predominance)

Second scoring system [SCORE B][5]: Each lung was given a score of 0–4 depending on the extent of lung involvement

Score	
0	No lung involvement
Score 1	≤25% lung involvement.
Score 2	25–50% lung involvement
Score 3	50–75% lung involvement
Score 4	≥ 75% lung involvement

A total severity score was calculated by adding severity scores of both lungs (total severity scores ranged from 0 to 8).

The correlation of the chest x-ray scores based on both the systems was compared with the lab parameters such as CRP, leukocyte count, D-dimer, Serum ferritin level.

STATISTICAL ANALYSIS:

- Data was entered in MS excel and analyzed using SPSS version 19.
- Continuous variables was presented as mean+SD or median (Q1, Q3).
- Categorical variables was presented as frequency and percentage.
- Pearson's correlation co efficient or Spearman's correlation coefficient was calculated to see the correlation between CRP,D-dimer, ferritin, leukocyte count and chest x-ray score.
- P value < 0.05 was considered as statistically significant.

RESULTS

Score A is the first chest x-ray scoring system. A1 is the score at first reading. A2 is the score at the second reading.

Score B is the first chest x-ray scoring system. B1 is the score at first reading. B2 is the score at the second reading.

Table 1: Distribution according to haematological findings (first reading)

Hematological Parameters	**Mean**
C- Reactive protein (CRP)	10.70± 11.08
Serum ferritin	557.31± 412.79
LDH	584.65± 991.76
D- Dimer	793.91± 1744.44

WBC	11.83± 11.8
Score A	9.23± 4.80
Score B	4.39± 2.08

In the study for all the 93 patients the first reading of hematological findings were noted as seen in table 1.

Table 2: Distribution according to hematological findings (second reading)

Hematological Parameters	**Mean**
C- Reactive protein (CRP)	13.61± 43.85
Serum ferritin	549.78± 407.96
LDH	441.97± 221.41
D- Dimer	2200.751± 3320.23
WBC	14.46± 11.37
Score A	8.43± 4.34
Score B	4.22± 1.99

In the study for all the 93 patients the second reading of hematological findings were noted as seen in table 2.

Table 3: Association between first reading of hematological findings and score A1

Association	**Mean**	**SD**	**95% CI**		**p-value**
			Lower	**Upper**	
CRP	10.61	11.13	1.476	4.240	0.33
Score A1	9.23	4.80			
Serum ferritin	557.31	412.79	447.65	650.38	**<0.001***
Score A1	8.29	4.19			
LDH	545.65	991.76	304.359	850.60	**<0.001***
Score A1	7.05	3.62			
D- Dimer	793.91	1744.44	336.04	1236.21	**<0.001***
Score A1	7.78	3.95			
WBC	11.83	11.80	1.04	6.04	**<0.006***
Score A1	8.89	4.19			
***Level of significance: p<0.05**					

Table 3 shows the association between first readings of hematological findings and score A1. A significant association was obtained between Score A1 and serum ferritin levels, LDH, D-dimer and WBC.

Table 4: Association between second reading of hematological findings and score A2

Association	Mean	SD	95% CI		p-value
			Lower	Upper	
CRP	13.61	43.85	4.71	17.08	0.26
Score A2	7.43	3.78			
Serum ferritin	549.78	40.7.96	439.54	645.155	<0.001*
Score A2	7.43	3.78			
LDH	441.97	221.41	376.57	493.47	<0.001*
Score A2	6.94	3.65			
D- Dimer	2200.75	3320.23	1350.81	3035.82	<0.001*
Score A2	7.43	3.78			
WBC	14.46	11.37	4.76	9.92	<0.001*
Score A2	7.12	3.70			
***Level of significance: p<0.05**					

Table 4 shows the association between first readings of hematological findings and score A2. A significant association was obtained between Score A2 and serum ferritin levels, LDH, D-dimer and WBC.

Table 5: Association between first reading of hematological findings and score B1

Association	Mean	SD	95% CI		p-value
			Lower	Upper	
CRP	10.61	11.13	3.56	8.87	**<0.001***
Score B1	4.39	2.08			
Serum ferritin	557.31	412.79	451.41	655.18	**<0.001***
Score B1	4.05	1.87			
LDH	545.65	991.76	307.97	854.36	**<0.001***
Score B1	3.49	1.65			
D- Dimer	793.91	1744.44	339.70	1240.54	**<0.001***
Score B1	3.78	1.75			
WBC	11.83	11.80	5.12	10.52	**<0.001***
Score B1	4.01	1.87			
***Level of significance: p<0.05**					

Table 5 shows the association between second readings of hematological findings and score B1. A significant association was obtained between Score B1 and CRP, serum ferritin levels, LDH, D- dimer and WBC.

Table 6: Association between second reading of hematological findings and score B2

Association	Mean	SD	95% CI		p-value
			Lower	Upper	
CRP	13.61	43.85	1.21	20.81	0.08
Score B2	3.82	1.84			
Serum ferritin	549.78	40.7.96	442.73	649.18	<0.001*
Score B2	3.82	1.84			
LDH	441.97	221.41	379.49	497.27	<0.001*
Score B2	3.58	1.78			
D- Dimer	2200.75	3320.23	1354.06	3.39.80	<0.001*
Score B2	3.82	1.84			
WBC	14.46	11.37	8.03	13.55	<0.001*
Score B2	3.67	1.81			
***Level of significance: p<0.05**					

Table 6 shows the association between second readings of hematological findings and score B2. A significant association was obtained between Score B2 and serum ferritin levels, LDH, D- dimer and WBC.

DISCUSSION

A study by Abdelwalhed A, Ahmed A et al. showed a positive correlation the selected laboratory test values and the total severity score (TSS) of CXR. There was an obvious and statistically significant increase in the blood WBC count, serum CRP with an increase in the radiographic severity score (a change in total pulmonary radiographic scoring categories from no pulmonary involvement to low score and high score categories). Most patient had air opacities predominantly in the lower zones and in the peripheral aspect[6]

Another study by Guan et al. detected a significant increase in LDH, CRP, D-dimer and worsening of chest radiographs in patients with severe disease than in patients with mild disease.[7]

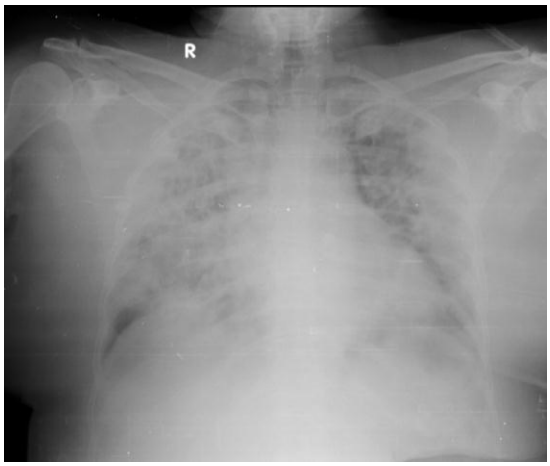
Study by Wang et al showed High CRP, WBC and LDH levels in COVID-19 patients (due to inflammatory reaction and tissue destruction) indicate a more severe illness and worse prognosis with lung damage.[8]

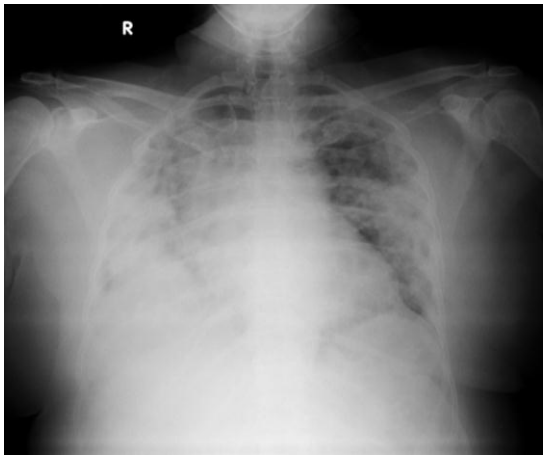
According to study by Gatti et al. showed that CRP and LDH is a major predictor of chest x-ray findings.[9]

Another study by Nava-Munoz Á et al showed association between the laboratory values (CRP, D-Dimer, Serum ferritin, and LDH) and the X-ray severity scores. All laboratory values increased as the X-ray severity score increased which was a similar finding in the

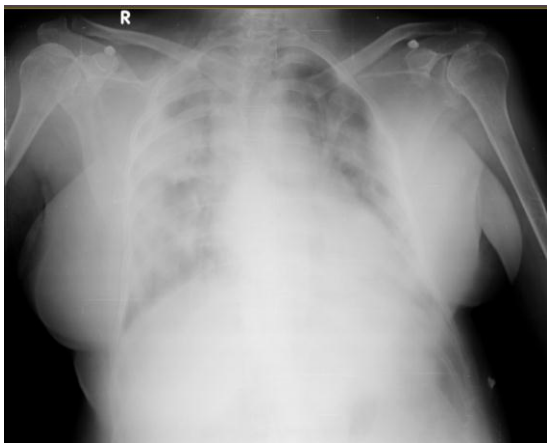
present study. Lymphocyte count and lymphocyte-to-leukocyte ratio, decreased as involvement on X-ray increased which was a contrary to the findings in the present study.[10] Ground glass opacities were predominant in early-phase (≤ 7 days since symptoms' onset), while crazy-paving pattern, consolidation, and fibrosis characterized late-phase disease (> 7 days).

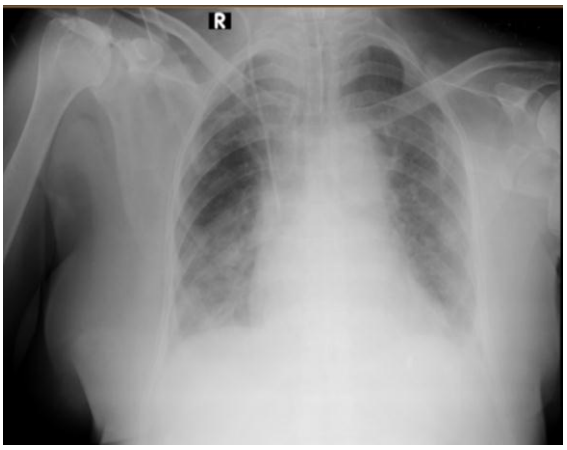
In our present study there is a significant correlation between the lab parameters (CRP, LDH, D-Dimer, WBC and ferritin) and the chest radiograph scores. This is similar ro the above studies. As the disease progressed the laboratory markers and chest x-ray scores worsened.The most common chest Xray findings were ground glass opacities and consolidation, which had a peripheral and basal predominance.



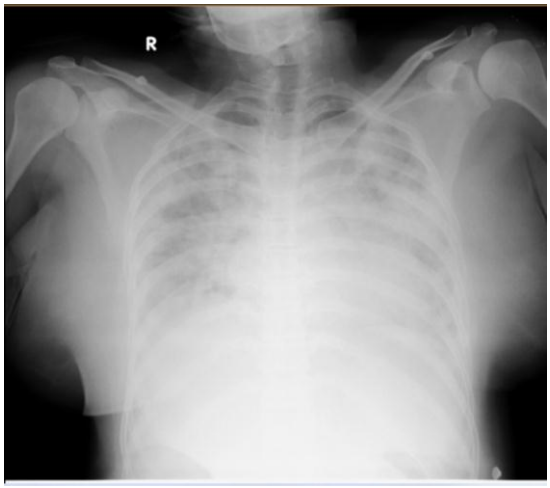


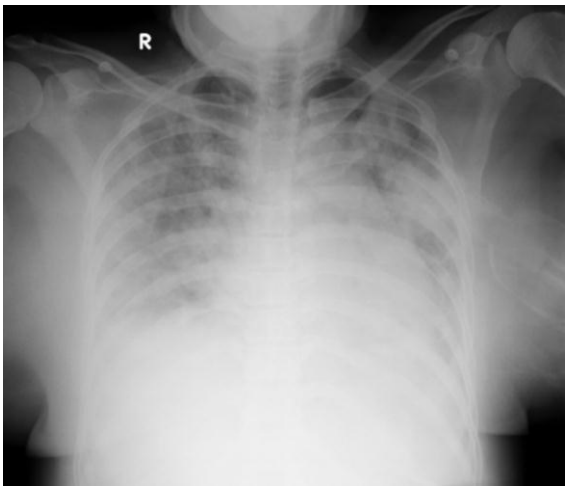
Score A1: 18 Score B1:8 Score A2: 13 Score B2: 5





Score A1: 14 Score B1:7 Score A2: 7 Score B2:5





Score A1: 18 Score B1: 8 Score A2: 12 Score B2: 6

Conclusion

The present study was undertaken to study the correlation between laboratory parameters and chest x- ray findings in COVID patients. The study concludes increased/ abnormal laboratory values increased with the severity of chest x-ray scores.

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