ORIGINAL ARTICLE

Relationship between High Resolution CT Chest and Laboratory Parameters- An Assessment Tool for the Safe and Timely Management of Suspected/Confirmed Covid-19 Disease Patients

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ABSTRACT

Objective: To assess the relationship between radiological findings and laboratory parameters, for safe and timely management of COVID-19 disease patients.

Study Design: Retrospective observational study.

Place and Duration of Study: The study was conducted at COVID-19 isolation ward of Frontier Corps Hospital Quetta, from April 15th to June 30th, 2020.

Materials and Methods: Suspected COVID-19 (on the basis of history) patients, from April 15th to June 30th, 2020, were included in the study. Laboratory parameters including, Neutrophils, Lymphocytes, C-Reactive Protein (CRP) were retrospectively collected from medical records. Severity of lung changes on high resolution chest CT was scored according to the lung involvement (CO-RADS score 1-6). Spearman rank correlation was used to evaluate the relationship between CO-RADS score and laboratory parameters.

Results: A total of 50 patients (mean age 34.7 ± 6.46 years [standard deviation]; age range, 23-49 years) were evaluated. The patients underwent a total of 150 CT scans chest. CO-RADS was significantly co-related with neutrophils count at day 1 (r=0.93, *p*-value < 0.001), day 5 (r=0.47, *p*-value=0.001), day 14 (r=0.94, *p*-value<0.001), lymphocytes count at day 1 (r=0.15, *p*-value<0.001), day 5 (r=0.90, *p*-value<0.001), day 14 (r=0.83, *p*-value=0.004), CRP at day 1 (r=0.90, *p*-value=0.001), day 5 (r=0.36, *p*-value=0.011) and at day 14 (r=0.93, *p*-value=0.001).

Conclusion: The results of this study showed that the severity of lung involvement on high resolution CT (HRCT) chest positively correlate with laboratory parameters. The study provides an insight into the appropriate interval of chest CT to reduce radiation and promote timely management of COVID-19 patients.

Key Words: *COVID-19, CO-RADS Score, High Resolution CT Chest, Laboratory Parameters.*

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious acute respiratory disease caused by a novel coronavirus. It has spread rapidly all over the world as compared to other deadly viruses of the same family (SARS-CoV and MERS-CoV).[1] Previous studies have shown clinical, laboratory, and radiologic characteristics of COVID-19.[2] Hsu LY et al showed raised alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels in severe acute respiratory syndrome (SARS) patients.[3] The radiological findings of coronavirus disease includes bilateral infiltrates with ground-glass opacities and in advance cases (COVID-19 pneumonia) consolidation.[4] Pathological changes at cellular level showed diffuse alveolar damage.[5] Yao XH et al found that the biopsy specimens of the liver showed mild lobular and portal activity and moderate microvascular steatosis, which suggest that the injury maybe induced by novel coronavirus.[6] Heart

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specimens showed no pathological changes, suggesting coronavirus infection may not damage the heart directly.[7] In previous studies of critically ill patients with COVID-19, pathological changes in different organs, has been discussed but only little is known about association between lung changes and other organs involvement due to coronavirus.[8,9] The aim of this study is to assess the importance of laboratory parameters and the relationship between lung changes on high resolution CT scan and blood markers of infection to avoid unnecessary exposure to radiation and timely management.

Materials and Methods

After ethical committee approval and informed consent, fifty COVID suspected patients (as per history) at COVID-19 isolation ward of Frontier Corps Hospital Quetta from April 15th to June 30th, 2020[9], were included. Patients on mechanical ventilation; septic shock; other organ failures, who required intensive care management, age > 65 years and patients with normal CT-chest patients were excluded from the study. Laboratory parameters including Neutrophils, Lymphocytes and C-reactive protein (CRP) were collected from medical records, retrospectively. Severity of lung changes on high resolution chest CT (CO-RADS) was scored according to the lung involvement (score 1-6). Spearman rank correlation was used to evaluate the relationship between CO-RADS score and laboratory parameters.

Statistical Analysis

All statistical analyses were performed by using SPSS statistical software (version 16). Categorical variables were described as frequency rates and percentages, and quantitative variables were described using mean± SD values. All chest CT scores were correlated with laboratory parameters at using the Spearman rank correlation. Difference between laboratory and radiographic data was obtained using one-way analysis of variance (ANOVA) with post hoc Tukey's multiple comparison tests at a level of significance $P < 0.05$.

Results

A total of 50 patients (mean age 34.7±6.46 years) were evaluated. COVID-PCR negative cases were 14 (28.0%) and 36 (72.0%) were positive. Among males 13 (35.1%) were COVID-19 PCR negative and 24 (64.9%) were positive. Among females 1 (7.7%) was COVID PCR negative and 36 (72.0%) were found

positive (Table 1).

The patients underwent a total of 150 CT scans chest. CO-RADS was significantly co-related with neutrophils count at day 1 (r=0.93, p-value < 0.001), day 5 (r=0.47, p-value=0.001) , day 14 (r=0.94, p-value<0.001), lymphocytes count at day 1 (r=0.15, p-value<0.001), day 5 (r=0.90, p-value<0.001), day 14 (r=0.83, p-value=0.004), CRP at day 1 (r=0.90, p-value=0.001), day 5 (r=0.36, p-value=0.011) and at day 14 (r=0.93, p-value=0.001).

Table 1: Demographic features

	PCR COVID-19	
	Negative	Positive
Gender		
Male n (%)	13 (35.1%)	24 (64.9%)
Female n (%)	1 (7.7%)	12 (92.3%)
Total n (%)	14 (28.0%)	36 (72.0%)

Table 2: Day-1 Lab parameters versus CT Scan Chest

Polymerase chain reaction	Neutrophils at Day-1	Lymphocytes at Day-1	CRP at Day-1	CO-RADS at Day-1	p-value
Negative					
Mean ± Std.DN	87.9+3.88 14	10.0+2.81 14	54.6+13.96 14	3.71+1.13 14	
Positive					
Mean± Std.DN	89.6+4.32 36	11.5+3.72 36	53.1+14.8 36	3.77+0.59 36	
Total					
Mean± Std.DN	89.1+4.23 50	11.1+3.52 50	53.6+14.8+13.54 50	3.77+0.77 50	0.001

Table 3: Day-5 Lab parameters versus CT Scan Chest

Polymerase chain reaction	Neutrophils at Day-5	Lymphocytes at Day-5	CRP at Day-5	CO-RADS at Day-5	p-value
Negative					
Mean ± Std.DN	73.14+6.68 14	17.00+3.92 14	50.00+12.2 14	2.85+0.53 14	
Positive					
Mean± Std.DN	74.94+7.15 36	15.91+4.87 36	43.05+13.6 36	3.02+0.65 36	
Total					
Mean± Std.DN	74.4+7.01 50	16.2+4.61 50	45.0+13.54 50	2.98+0.62 50	0.001

Discussion

The study showed that the degree of lung involvement on high resolution chest CT was correlated with blood markers of infection in COVID-19 patients. In previous studies, laboratory markers like D-Dimer, fibrinogen and C-reactive protein (CRP) between COVID-19 mild and severe cases, were significantly different.[10] Fan et al. study on laboratory parameter of lymphocyte count and lactate dehydrogenase (LDH) level between COVID-19 intensive care unit (ICU) and non-ICU patients

showed increased lactate dehydrogenase (LDH) and lymphopenia in ICU patients.[11] Literature showed that MERS-CoV patients had deranged liver function with raised aspartate aminotransferase (AST) and alanine aminotransferase (ALT) and LDH. Similarly, SARS patient showed raised CRP aminotransferase, creatine kinase and LDH along with lymphopenia and leukopenia.[12,13] Recently published articles have also showed clinical and epidemiological characteristics of COVID-19 disease patients, but still patient's data regarding laboratory characteristics are limited.[14]

High resolution chest CT a useful and effective tool to assess progress of disease according to the severity of COVID-19, and plays vital role in patient's management.[15] During acute infection, neutrophils act by phagocytosis and oxidative burst and, may contribute to organ damage and death, by forming extracellular traps.[16,17] Neutrophil count was related to severity of disease according to literature. Infection-related biomarkers included white blood count, CRP, neutrophils and procalcitonin usually elevated due to progression of disease.[18] Likewise, severe COVID on Chest CT showed diffuse ground glass opacities with consolidation.[19] In critically ill COVID patients infection-related biomarkers, regulated by inflammatory cytokine, are grossly deranged.[20]

Literature showed that neutrophil count is related to the severity of disease and neutrophil infiltration was also noted in pathological findings from autopsied COVID-19 patients. Other biomarkers like C-reactive protein and procalcitonin also gets elevated.[21,22] Radiological findings showed diffuse alveolar damage with inflammatory cell infiltration in this stage. Accordingly, chest CT showed consolidation with ground glass opacities.[23] Due to low immune functions, patients with severe viral infection are get co-infected with bacteria.[24] Cytokine storm in severe and critically ill patients with COVID-19 might be associated with the activity of these infection-related biomarkers regulated by inflammatory cytokine.[25] The decrease in lymphocytes in COVID-19 patients indicates that a large number of immune cells are consumed and the immune function is inhibited. The increase in neutrophil count, procalcitonin and C-reactive protein may be associated with cytokine storm due to viral invasion along with bacterial coinfection.[26]

Timely prevention of infection may help reduce complication and mortality. Computed tomography plays an important role in the diagnosis and disease severity evaluation of this disease.[27]

There were some limitations of the study. Firstly, it was a retrospective study and the sample size was comparatively small. Therefore, more studies are required for the confirmation of investigatory findings.

Conclusion

The results of this study showed that the severity of lung involvement on high resolution CT (HRCT) chest positively correlate with laboratory parameters and this provides an insight into the appropriate interval of chest CT to reduce radiation and promote timely management of COVID-19 patients.

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