

Effects of Post COVID-19 Pneumonia on the Prognosis of Trauma Patients undergoing Treatment in a Tertiary Care Hospital

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Conflict of interest: Nil

Abstract

Background: In the light of post severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) Pneumonias playing a role in the long-term respiratory complications in patients subsequently involved in trauma, a study was conducted to assess the post COVID-19 Pneumonias on the prognosis of trauma patients in a Tertiary care Hospital of Telangana.

Aim of the Study: To identify the post COVID-19 pneumonia and respiratory complications, their severity, factors affecting the management of trauma patients and the long-term sequelae.

Materials: 42 patients categorized on American Association for the Surgery of Trauma (AAST) injury scoring scales were included. Patients aged between 18 and 70 years were included. Patients with previous history of post COVID-19 lung disease for 09 months or above were included. Pulmonary function tests like FEV1, FVC, TLC and DLCO were performed and analyzed. The CT scan signs were based on the involvement of the lung parenchyma as: Normal CT (no lesion), minimal (0–10%), moderate (11–25%), important (26–50%), severe (51–75%), and critical (>75%).

Results: 42 patients with trauma with either COVID-19 disease affecting the lungs or RTPCR positive were included. There were 29 (69.04%) male patients and 13 (30.95%) female patients with a male to female ratio of 2.23:1. The mean age among the men was 41.55±3.25 years and 38.15±4.10 years in female patients. There were 33/42 patients with positive RTPCR test and 09/42 were negative for RTPCR test for COVID-19.

Conclusions: Recovery from COVID-19 disease especially with lung parenchyma changes during the active state have shown to affect adversely the morbidity of post trauma surgeries. Preoperative assessment of Lung function tests such as FEV1, FVC, TLC and DLCO would guide the surgeon and the anesthetist in the surgical management of such patients.

Keywords: Lung, COVID-19, Sars CoV-2, Parenchyma, Trauma and Long COVID.

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Introduction

The Global pandemic of COVID was caused by the novel virus severe acute respiratory syndrome Corona virus 2 (SARS-Cov-2) in 2019 and a relapse in 2020 [1]. The Acute COVID-19 disease was characterized by fever, cold, cough; GIT symptoms [2], CNS symptoms [3] but many were asymptomatic [4].

Many patients were asymptomatic and few required hospitalization and ventilator support and overall duration of the COVID-19 disease was from 1 to 4 weeks [5]. In a study of COVID-19 patients by follow up for 9 months revealed nearly 30% complained of persistent symptoms [6]. Such patients were given a name as Long COVID, Post acute COVID-19 syndrome (PACS), or post-acute sequelae of COVID-19 [7].

Post-acute sequelae SARS-CoV-2 infection (PASC) symptoms could be due to organ injuries during acute disease period caused by SARS-Cov-2, or associated inflammatory process and/or disturbed clotting mechanisms [8]. Guler *et al* from their study of 4 months in patients with SARS-Cov-2 infection, severe COVID-19 found that significant radiological and functional abnormalities of lung parenchyma, small airway disease [9].

Rai *et al* from their study in 2020 observed many of their patients had lung fibrotic abnormalities [10]. It was characterized by marked scar tissue in the lungs. Mc Donald stated that such lung scarring could remain stable or may progress due to further infection or injury [11]. He stated that in both the cases it may lead to deposition of extra cellular matrix molecules such as fibrinectin, collagen and laminin in parenchymal lung tissue which further leads to epithelial and endothelial damage and thickened alveolar walls resulting in

impaired gaseous exchange at alveolar levels. This could result in fatigue, dyspnea and exercise intolerance. Keeping these studies in view the present study was conducted to identify the post COVID-19 Pneumonias and respiratory complications, their severity, factors affecting the management of trauma patients and the long term sequelae.

Materials

Type of Study: A cross sectional analytical study

Institute of Study: Government Medical College, Paloncha, Bhadradi, Kothagudem, Telangana- 501118

Period of Study: November 2021 to March 2023.

42 patients with different types of major trauma (American Association for the Surgery of Trauma (AAST) injury scoring scales), (12) attending the department of Orthopedics, Government Medical College, Paloncha, Bhadradi, Kothagudem, Telangana were included in the study. An institutional ethics committee clearance was obtained. An ethics committee approved consent form was used.

Inclusion Criteria: Patients aged between 18 and 70 years were included. Patients of both the genders were included. Patients with previous history of COVID-19 disease 09 months or above after discharge were included. Patients with clinico-radiological features of pulmonary involvement were included. Patients either positive or negative for RTPCR for COVID-19 disease were included. Patients with persistent symptoms of COVID-19 disease were included. Patients with no clinico-radiological features of COVID-19 also were included.

Exclusion Criteria: Patients below 18 and above 70 years were excluded. Patients with

co-morbidities like Diabetes Mellitus, Cardiovascular diseases, immune deficiency diseases, renal diseases (CKD) were excluded. Patients not willing to participate in the study were excluded. Patients with severe trauma were excluded (American Association for the Surgery of Trauma (AAST) injury scoring scales) were used. All the patients were elicited about the past history of COVID-19 disease as per the inclusion criteria. A thorough clinical examination of respiratory system was done. Pulmonary function tests were done and the values were grades as follows:

Mean Pulmonary function tests values:
FEV₁: FEV₁ >70%- mild, FEV₁ 60-69%- moderate, FEV₁ 50-59%- moderately, severe, FEV₁ 35-49%- severe, FEV₁<35%- very severe.

FVC: Normal: 80 to 120%, Abnormal-<80%.

TLC: Normal: 80 to 120%, Abnormal-<80%.

DLCO: Normal: >75% to 140%, Mild: 60% to LLN (lower limit of normal), Moderate: 40% to 60%, Severe: <40%. Oxygen saturations at the time of admissions were noted. X-Ray chest AP view was taken in all the patients and where necessary CT scan of the chest was done. The CT scan signs were based on the involvement of the lung parenchyma and the percentage of involvement: Normal CT (no lesion), minimal (0–10%), moderate (11–25%), important (26–50%), severe (51–75%), and critical (>75%), (13) and to simplify the analysis of the clinical data, the patients were divided into three subgroups $\leq 25\%$, 26–50%, and >50%.

Whenever surgery was needed the ASA classification was done to grade the fitness for anaesthesia. Appropriate medical or surgical treatment was initiated and the patient was observed during the stay and the

variable was noted (pulse, oxygen saturations, respiratory rate, pulmonary function tests and 2D Echo). Duration of Hospital stay was recorded. Statistical analysis was done using percentage, mean, standard deviation, percentages and chi-square test to assess the significance.

Results

42 patients with trauma were included in this study and those who had either COVID-19 disease affecting the lungs or RTPCR positive with or without other clinical signs were included. There were 29 (69.04%) male patients and 13 (30.95%) female patients with a male to female ratio of 2.23:1. The mean age among the men was 41.55±3.25 years and 38.15±4.10 years in female patients.

There were 33/42 (78.57%) patients with positive RTPCR test and 09/42 were negative for RTPCR test for COVID-19. There were 03 (07.14%) patients in the age group of 18 to 27 years, 09 (21.42%) patients in the age group of 28 to 37 years, 13 (30.95%) patients in the age group of 38 to 47 years, 07 (16.66%) patients in the age group of 48 to 57 years, 07 (16.66%) patients in the age group of 58 to 67 years and 03 (07.14%) patients in the age group above 67 years. (Table 1)

BMI was 25 to 30 in 11/42 (26.19%) patients, 30 to 35 in 20/42 (47.61%) patients and above 35 in 16/42 (38.09%) patients. Clinical severity of COVID-19 was assessed as per WHO guidelines and found that mild COVID-19 was observed in 08/42 (19.04%) patients, moderate COVID-19 was observed in 17/42 (40.47%) patients, severe COVID-19 was observed in 13/42 (30.95%) patients and critical COVID-19 was observed in 04/42 (09.52%) patients. (Table 1)

There were 33/42 (78.57%) RTPCR test positive patients who were hospitalized during the pandemic and 09/42 (21.42%)

patient who were not hospitalized but had COVID CT scan chest positive for COVID lung signs. CT scan chest showed lung parenchyma involved up to 25% in 10/42 (23.80%) patients, 26 to 50% lung involvement in 18/42 (42.85%) patients and >50% lung involvement in 14/42 (33.33%) patients. Pulmonary function tests were done

in all the patients in this study and the mean values observed were tabulated in the table 1. There was significant correlation between the age and COVID-19 clinical severity, Hospitalization and CT scan findings in the study (p value was 0.001; p taken as significant at <0.05), (Table 1).

Table 1: Showing the demographic data, CT scan findings and Pulmonary function tests results of the subjects in the study (n=42).

Observation	Male- 29	%	Female- 13	%	P value
RTPCR +ve- 33 (78.57%)	22	52.38	11	26.19	0.061
RTPCR -ve- 09 (21.42%)	07	16.66	02	04.76	0.237
Age					
18 to 27- 03 (07.14%)	02	04.76	01	02.38	0.113
28 to 37- 09 (21.42%)	06	14.28	03	07.14	
38 to 47- 13 (30.95%)	09	21.42	04	09.52	
48 to 57- 07 (16.66%)	05	11.90	02	04.76	
58 to 67- 07 (16.66%)	05	11.90	02	02.76	
67 to 70- 03 (07.14%)	02	04.76	01	02.38	
BMI					
25 to 30- 11 (26.19%)	08	19.04	03	07.14	0.251
30 to 35- 20 (47.61%)	13	30.95	07	16.66	
>35- 16- 16 (38.09%)	08	19.04	08	19.04	
COVID-19 clinical severity					
Mild- 08 (19.04%)	06	14.28	02	04.76	0.001
Moderate- 17 (40.47%)	13	30.95	04	09.52	
Severe- 13 (30.95%)	07	16.66	06	14.28	
Critical- 04 (09.52%)	03	07.14	01	02.38	
Hospitalized- 33 (78.57%)	22	52.38	11	26.19	0.001
Not Hospitalized- 09 (21.42%)	07	16.66	02	04.76	
CT scan Lesions					
≤25%- 10 (23.80%)	07	16.66	03	07.14	0.001
26–50%- 18 (42.85%)	12	28.57	06	14.28	
>50%- 14 (33.33%)	10	23.80	04	09.52	
Mean Pulmonary function tests values					
FEV1					
FEV1 >70%- mild- 10 (23.80%)	08	19.04	02	04.76	0.001
FEV1 60-69%- moderate- 12 (28.57%)	09	21.42	03	07.14	
FEV1 50-59%- moderately severe- 11 (26.19%)	07	16.66	04	09.52	
FEV1 35-49%- severe- 03 (07.14%)	03	07.14	03	07.14	
FEV1 <35%- very severe- 03 (07.14%)	02	04.76	01	02.38	
FVC					
80 to 120%	17	40.47	07	16.66	0.001
<80%	12	28.57	06	14.28	

TLC					
80 to 120%	08	19.04	06	14.28	
<80%	04	09.52	03	07.14	
DLCO					
Normal: >75% to 140%- 09 (21.42%)	05	11.90	04	09.52	
Mild: 60% to LLN (lower limit of normal)- 12 (28.57%)	07	16.66	05	11.90	
Moderate: 40% to 60%- 12 (28.57%)	09	21.42	03	07.14	
Severe: <40%- 08 (19.04%)	08	19.04	00	00	

(FEV1=forced expiratory volume in one second; FVC=forced vital capacity; TLC=total lung capacity; DLCO=diffusion capacity for carbon monoxide).

In this study the numbers of patients with different types of trauma were included as per the **American Association for the Surgery of Trauma (AAST) injury scoring scales and ASA grading** were tabled in **Table 2**.

Table 2: Showing the different types of trauma encountered and their ASA grading on the study (n-42).

Observation	Male- 29	%	Female- 13	P value
<u>Nature of trauma</u>				
<u>Orthopedic Trauma</u>				
Grade I	01	02.38	0	0
Grade II	01	02.38	01	02.38
<u>Chest wall Injury</u>				
Grade I	01	02.38	0	0
Grade II	01	02.38	0	0
Grade III	01	02.38	01	0
<u>Lung Injury</u>				
Grade I	01	02.38	01	02.38
Grade II	02	04.76	0	0
Grade III	01	02.38	01	02.38
<u>Spleen Injury</u>				
Grade I	01	02.38	0	0
Grade II	01	02.38	01	0
Grade III	01	02.38	01	
<u>Liver Injury</u>				
Grade I	02	04.76	01	02.38
Grade II	01	02.38	0	0
Grade III	01	02.38	01	02.38
<u>Stomach Injury</u>				
Grade I	02	04.76	01	02.38
Grade II	01	02.38	0	
<u>Small Bowel Injury</u>				
Grade I	01	02.38	00	0
Grade II	01	02.38	0	0
Grade III	01	02.38	01	02.38
<u>Colon Injury</u>				

Grade I	01	02.38	0	0
Grade II	02	04.76	01	02.38
Grade III	01	02.38	01	02.38
<u>Kidney Injury</u>				
Grade I	01	02.38	0	0
Grade II	01	02.38	01	02.38
Grade III	01	02.38	0	0
<u>ASA grading</u>				
ASA I	10	25.80	05	11.90
ASA II	14	33.33	06	14.28
ASA III	03	07.14	01	02.38
ASA IV	02	02.38	01	02.38

Patients undergoing treatment for different types of trauma with post COVID-19 lung lesions were tabulated in Table 3.

Table 3: Showing the complications observed in post COVID-19 lung diseases on trauma patients (n-42)

Observations	Number	%	P value
<u>Management</u>			
Surgical	35	83.33	0.117
Medical	07	16.66	
<u>Anaesthetic complications</u>			0.001
Prolonged Hypoxia	04	09.52	
Pulmonary embolism	01	02.38	
Arrhythmias	03	07.14	
Pneumonia	01	02.38	
ARDS	01	02.38	
<u>Coagulation defects</u>			0.114
DVT	01	02.38	
<u>Wound dehiscence</u>	03	07.14	0.241
Infection	03	07.14	0.314
Hemorrhage	04	09.52	0.001
Delayed wound healing	05	11.90	0.001
TOTAL	26	61.90	0.001

The data was analyzed correlating the post COVID-19 patients who have met with different types of trauma with their pulmonary function values, CT scan lung parenchyma involvement and related physiological characteristics like BMI at the end of their treatment. The age of the patients was found to correlate positively with the Covid-19 clinical severity, Hospitalizations, and mean Pulmonary

function tests values of FEV1 >70%- mild, FEV1 60-69%- moderate, FEV1 50-59%- moderately severe, FEV1 35-49%- severe, FEV1<35%- very severe.

FVC: Normal: 80 to 120%, Abnormal-<80%.

TLC: Normal: 80 to 120%, Abnormal-<80%.

DLCO: Normal: >75% to 140%, Mild: 60% to LLN (lower limit of normal), Moderate: 40% to 60%, Severe: <40%. The p value was 0.001 (p value significant at <0.05) in patients with complications such as anaesthetic complications, Haemorrhage and delayed wound healing. (Table 3) It was observed that CT scan lung lesions showing lung parenchyma involvement more than 50% at eight months after discharge and History of hospitalization during the pandemic of COVID-19 was a risk factor for higher morbidity and complication rate. (p value 0.001; p taken as significant at <0.05) The abnormal DLCO at nine months after discharge (p=0.001, Table 3) was associated with patients with haemorrhage and wound dehiscence. (Table 3)

In the present study out of 42 patients the parenchyma lesions of COVID-19 was the prime prognostic factor in the final outcome of the different types of trauma for which they were admitted. Among the 42 patients, the patients with less than 25% lung involvement; 10 (23.80%), none developed complications. Patients with more than 50% lung involvement who were admitted to the ICU developed most of the complications. In multivariate analysis, patients with lung involvement >50% were significantly associated with complications. (p < 0.001). All the patients were managed by surgery and appropriate medical treatment in this tertiary care Hospital. The average Hospital stay was 11.25±3.10 days. There was no mortality in this study despite severe lung involvement due to COVID-19 disease.

Discussion

The present study was conducted in a tertiary care Hospital among the patients who were treated for COVID-19 disease previously during the COVID pandemic with or without RTPCR test positive, with Lung lesions and subsequently meeting with organ trauma and admitted in the General

Surgery department for further treatment. All the patients had undergone treatment for COVID lung disease more than 09 months earlier.

The majority of the patients in this study were hospitalized and very few had critical illness. This study also includes patients with milder disease severity, which among the general population is the common severity of disease.

Patients, who underwent hospitalization, had abnormal chest imaging and abnormal lung function test values. In this study evaluation of pulmonary function tests was done in all and was taken as the baseline before starting the actual treatment for the trauma. 21/42 (50%) patients in this study had abnormal pulmonary function test values. Totally 26/42 (61.90%) of the patients developed complications as tabulated in the Table 3.

By evaluating the trauma patients before starting the actual treatment especially in these post COVID lung disease has allowed us to prepare the patients pre-operatively while subjecting them for various types of anaesthesia for surgery and treating them post-operatively. Similar study was conducted by Torres-Castro R *et al* [14]. wherein they observed the post COVID lung lesions played an important role in the morbidity of post-surgical patients.

The present study has provided an right insight on prognosis for post COVID -19 patients with mild to severe disease manifestations during the pandemic which were enough to predict the final outcome [15]. 08 (19.04%) of the patients in this study had mild COVID-19 clinical grading not requiring hospitalization as observed in a similar study by Zhao Y.-M, Shang Y.-M *et al* [16,17]. A study by Hui D.S, Wong K.T *et al* [18] who evaluated CT scan findings of post COVID-19 patients showed that patients with lung lesions progressed to fibrosis were more likely to have an

increased risk of morbidity, when they encounter orthopaedic trauma and require surgical interventions. In this study 32/42 (76.19%) patients had abnormal DLCO levels and among them 26/32 (81.25%) patients developed different types of complications as mentioned in the Table 1.

These patients might have these abnormal DLCO values even after 09 months of post COVID-19 lung disease identified in them. The correlation between DLCO levels was significant in this study as the p value was 0.001. Huang Y. Tan C. Wu J. *et al* from their similar study postulated that it was possible that the decreased levels of DLCO in previously COVID-19 affected patients with pulmonary lesions were prone for infections and other complications like hemorrhages and wound dehiscence.

Limitations to the present study was that it was a small sample size and from only one center. This study included mild and moderate disease with 20% of patients being severe or critical disease; with a large sample study and preferably about half of the cohort size, evaluating PFT after infection with COVID-19 would be most welcome.

Conclusions

Recovery from COVID-19 disease especially with lung parenchyma changes during the active state have shown to affect adversely the morbidity of post trauma orthopaedic surgeries. Preoperative assessment of Lung function tests such as FEV1, FVC, TLC and DLCO would guide the surgeon and the anesthetist in the surgical management of such patients.

A prior CT scan image of lung involvement with COVID-19 has a direct predictive value of the final outcome of the post operative period.

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