International Journal of Advances in Medicine
*Kumar Shrawan et al. Int J Adv Med. 2021 Dec;8(12):1841-1845*
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: https://dx.doi.org/10.18203/2349-3933.ijam20214521

**Original Research Article**

# Clinico-pathological changes in COVID-19 patients

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**Received:** 07 October 2021
**Revised:** 12 November 2021
**Accepted:** 13 November 2021

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## ABSTRACT

**Background:** Novel Corona virus is associated with the respiratory disorder. Corona virus cases disease ranging from a common cold like illness severe acute respiratory syndrome. Biochemical parameters become altered in the patients, and this has been correlated with the severity of the disease. The present study was undertaken to analyse the effect of novel corona virus infection in organs other than lungs.
**Methods:** The study is a retrospective studycarried out in RMCH and RC, Kanpur from July 2020 to June 2021. Haematological, biochemical and inflammatory biomarker study was conducted in 336 COVID-19 patients.
**Results:** Out of 336 COVID-19 patients the maximum number of patients belonged to the age group of 61-70 years. There were 75% symptomatic and 25% asymptomatic cases of confirmed COVID-19. Sore throat was the most common presentation followed by cough and dyspnoea. Other manifestations include fever, myalgia, loss of taste, loss of smell and running nose. Serum CRP and PCT concentration were observed in more severe cases 22.2% and 17% respectively. Haematological findings include decrease in total RBC count (58.33%). Symptomatic COVID-19 patients have thrombocytopenia (30.95%), lymphopenia (25%), leucocytosis (11.90%) and leucopenia 8.33%. Hepatic dysfunction and renal dysfunction was observed in 71.42% and 14.28% symptomatic cases respectively.
**Conclusions:** We concluded that novel corona virus is not only affecting respiratory system but also other vital organs. On the basis of haematological and biochemical findings we can predict the severity of COVID-19 infection which could be helpful for management of the disease.

**Keywords:** COVID-19, Haematological finding, Biochemical finding

## INTRODUCTION

Corona Virus-2, or more popularly known as Novel Corona Virus, is associated with the respiratory disorder in humans which has been declared as a global epidemic and pandemic in the first quarter of the year 2020 by the World Health Organization (WHO).[1] The SARS-CoV-2 virus has profoundly impacted the economy, environment, health, and social structure of the globalized world.[2,3] When infecting humans, Novel Corona virus can cause diseases of varying severity, from upper respiratory tract infections similar to a common cold, to liver, enteric, neurological diseases and lower respiratory tract infections such as pneumonia, bronchitis and severe acute respiratory syndrome (SARS).[4-6] The clinical laboratories play a crucial role in assessing severity of disease, choosing the suitable treatment options and monitoring the response in addition to diagnosis of COVID-19.[7] The accumulated evidence has shown that many biochemical parameters become altered in COVID-19 patients, and this has been correlated with the severity of the disease and in some cases associated with the prognosis of the patients.[8] C reactive (CRP)protein is a most popular biological marker for prognosis of the disease. CRP is a protein discovered

in the 1930s by Tillett and Francis and is an acute phase reactant. It is a pentameric protein which is synthesized by the liver under the action of cytokine interleukin-6 (IL-6). A very high level of is mostly associated with bacterial infections but elevated levels are also seen in injuries, cardiovascular processes and other inflammatory states. Elevated CRP levels not only suggest a pro-inflammatory state but also can be used as a prognostic marker for the underlying disease processes.[9] The present study was undertaken to analyse the effect of novel corona virus infection in organs other than lungs.

## METHODS

This is a retrospective study conducted in Rama Medical College, Hospital and Research Centre, Kanpur, UP from July 2020 to June 2021.

### *Inclusion criteria*

Lab confirmed COVID-19 patients either symptomatic or asymptomatic of 21-year to 80-year age group and both genders were included in the study.

### *Exclusion criteria*

Patient having pre-existing co-morbidities except diabetes and hypothyroidism were excluded in the study.

This study was conducted among 336 patients with SARS CoV-2 infection admitted in RMCH and RC, Kanpur. The patients were diagnosed as COVID-19 by RT-PCR test admitted. The patient's data was collected from the medical records department of the hospital. The severity of disease was classified as per the revised guidelines on the clinical management of COVID-19 by the Ministry of Health and Family Welfare, Government of India.[30]

### *Data collection and statistical analysis*

The data was collected from Microbiology department as well as Medical Record Department of the hospital. Data entry and statistical analysis was performed with the help of Statistical package for social sciences (SPSS) version 22. In the present study, the statistical methods used for quantitative data were descriptive statistics presented by n, mean, and range.

## RESULTS

A total of 336 laboratory confirmed adult COVID-19 patients admitted were included for the study. The maximum number of patients belonged to the age group of 61-70 years. The mean age was 42.37 (±19.02) years with age groups ranging from 20 to 80 years. Out of 336 cases, 203 (60.41%) and 133 (39.58%) were male and female respectively. The male:female ratio being 2:1.

The age and gender distribution is as shown in Table 1.

**Table 1: Age and gender wise distribution of COVID-19 patients (n=336).**

| Age interval (in years) | Male | Female | Total | Percentage |
|---|---|---|---|---|
| **11-20** | 12 | 36 | 48 | 19.05 |
| **21-30** | 59 | 24 | 83 | 32.94 |
| **31-40** | 13 | 24 | 37 | 14.68 |
| **41-50** | 11 | 14 | 25 | 9.92 |
| **51-60** | 46 | 0 | 46 | 18.25 |
| **61-70** | 60 | 35 | 95 | 37.69 |
| **71-80** | 2 | 0 | 2 | 0.79 |
| **Total** | 203 | 133 | 336 | |

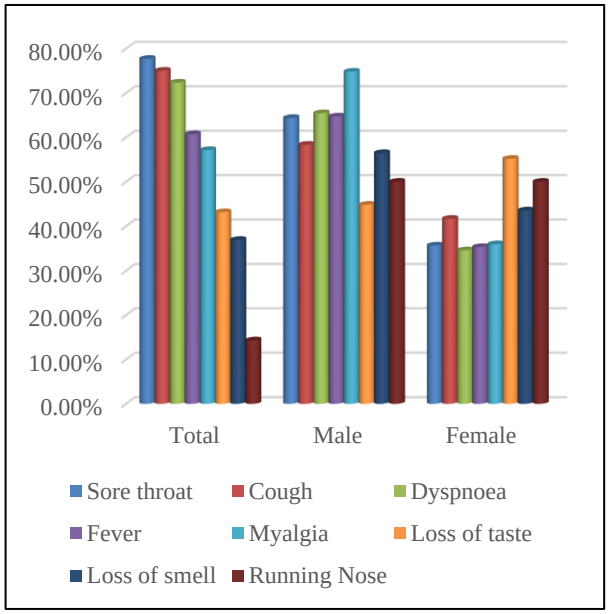


**Figure 1: Clinical presentation of symptomatic COVID-19 patients.**

There were 252 (75%) symptomatic and 84 (25%) asymptomatic cases of confirmed COVID-19 cases by real time polymerase reaction (RT-PCR) test. Out of 252 symptomatic cases, 63 were more severe (Severe pneumonia) and 189 were less severe (mild pneumonia). Sore throat (77.67%) was the most common presentation followed by cough (75%) and dyspnoea (72.32%). Other manifestations include Fever (60.71%), Myalgia (57.14%), loss of taste (43.15%), loss of smell (36.90%) and running nose (14.28%). The distribution of symptoms is as shown in Figure 1.

### *Examination of Inflammatory biomarkers*

C-reactive protein (CRP) and pro calcitonin (PCT) concentration in asymptomatic COVID-19 cases was observed below normal level. Comparatively serum C-reactive protein (CRP) concentration observed in more severe cases 56/252, 22.2% (>130 mg/L versus 50-100 mg/L, p=0.001), admitted in ICU. Similarly, increased

serum pro calcitonin (PCT) has observed in more severe cases 43/252, 17% (>1.66 ng/mL, p=0.001). The distribution of haematological parameters is as shown in Table 2.

**Table 2: Haematological analysis of symptomatic COVID-19 cases (n=252).**

| Lab Parameters | Abnormalities | No. of cases | Percentage |
|---|---|---|---|
| **TLC** | Increase | 30 | 11.90 |
| | Decrease | 21 | 8.33 |
| **TRBC** | Increase | 57 | 22.61 |
| | Decrease | 147 | 58.33 |
| **Hb** | Decrease | 126 | 50 |
| **PCV** | Decrease | 120 | 47.61 |
| **MCV** | Increase | 15 | 5.95 |
| | Decrease | 102 | 40.47 |
| **MCH** | Increase | 57 | 22.61 |
| | Decrease | 66 | 26.19 |
| **MCHC** | Increase | 15 | 5.95 |
| | Decrease | 57 | 22.61 |
| **Platelet** | Decrease | 78 | 30.95 |
| **RDW** | Increase | 78 | 30.95 |
| **Polymorphs** | Increase | 54 | 21.42 |
| | Decrease | 6 | 2.38 |
| **Lymphocytes** | Increase | 21 | 8.33 |
| | Decrease | 63 | 25 |

The most common haematological findings include decrease in total RBC count (58.33%) followed by decreased haemoglobin concentration (50%) and decreased packed cell volume (47.61%) which is suggestive of anaemia whereas decreased MCV (40.47%) is suggestive of microcytosis i.e. microcytic anaemia. Out of 252 symptomatic cases 78 (30.95%) of COVID-19 patients have thrombocytopenia, 63 (25%) have lymphopenia, 30 (11.90%) have leucocytosis and 21 (8.33%) have leukopenia.

***Examination of liver function***

Among asymptomatic COVID-19 cases liver function test findings were normal. The most common biochemical findings for liver function in symptomatic in mild COVID-19 patients include increased SGOT 180/252 (71.42%), SGPT 156/252 (61.90%) and bilirubin direct 66/252 (26.19%) whereas decreased total serum protein 60/252 (23.80%) and serum albumin 75/252 (22.61%). Overall, 180 (71.42%) symptomatic COVID-19 patients were diagnosed as hepatic dysfunction during course of the disease. Abnormal liver function was observer in all diabetic patients. All differences are statistically significant in severe cases of COVID-19 except SGOT (p-0.26) in which statistical significance was not found. The biochemical findings of liver function tests are as shown in Table 3.

**Table 3: Biochemical analysis of symptomatic COVID-19 patients (n=252).**

| Biochemical parameters | Abnormalities | No. of mild cases (189) | No. of severe cases (63) | P value |
|---|---|---|---|---|
| **Bilirubin Total** | Increase | 15 | 54 | 0.001 |
| **Bilirubin Direct** | Increase | 66 | 62 | 0.001 |
| **Serum Protein** | Decrease | 60 | 59 | 0.001 |
| **Serum Albumin** | Decrease | 57 | 61 | 0.001 |
| **SGOT** | Increase | 180 | 62 | 0.26 |
| **SGPT** | Increase | 156 | 63 | 0.008 |
| **Alkaline phosphatase (ALP)** | Increase | 36 | 61 | 0.001 |
| **Blood Urea** | Increase | 27 | 61 | 0.001 |
| **Serum Creatinine** | Increase | 9 | 62 | 0.001 |
| **Serum Uric Acid** | Increase | 36 | 62 | 0.001 |
| **Blood glucose level** | Increase | 26 | 53 | 0.001 |
| **T3** | Decrease | 19 | 46 | 0.001 |
| **T4** | Decrease | 19 | 46 | 0.001 |
| **TSH** | Increase | 21 | 46 | 0.001 |

***Examination of kidney function***

Among asymptomatic COVID-19 cases kidney function test findings were normal. The most common biochemical findings for kidney function in symptomatic COVID-19 patients include increased serum uric acid 36/252 (14.28%) and serum creatinine 9/252 (3.57%). Overall, 36 (14.28%) symptomatic COVID-19 patients were diagnosed as abnormal kidney function during course of the disease. Abnormal kidney function was observer more in diabetic patients and hypothyroidic patients. The

biochemical findings of kidney function tests are as shown in Table 3.

## DISCUSSION

In this study, our objective was to find out the pathological changes in COVID 19 patients with the help of different haematological and biochemical test and to compare them according to the severity of the infection.

The maximum number of patients belonged to the age group of 61-70 years. The study was in contrast with the study conducted by Patel et al where the maximum number of patients belonged to the age group of 51-60 years.[10] Males were predominant and the results were in accordance with Hasan et al and Bhandari et al.[11,12]

Sore throat (77.67%) was the most common presentation followed by cough (75%) and dyspnoea (72.32%). In other studies fever and cough was the major clinical manifestation.[11,13] Our results were also in contrast with Agarwal et al who concluded dyspnea as the most common presentation.[14]

In this study 30.95% patients had thrombocytopenia whereas Chen et al and Fan et al found it to be 12% and 20% respectively.[15,16] The potential reasons for thrombocytopenia include direct effect of SARS-CoV-2 on platelet production, autoimmune destruction of platelets, or increased plateletconsumption.[17]

Our results were in accordance with Chen et al who found 9% patients had leucopenia and 51% showed reduced haemoglobin level.[14] Using a bioinformatics approach, Liu and Li proposed certain SARS-CoV-2 proteins may attack the beta chain of haemoglobin, thus reducing its level.[18] A reduction in haemoglobin (and thus oxygen content) may explain some of the symptoms of respiratory distress. A few studies found no significant changes in haemoglobin levels in COVID-19 patients.[19,20] Although Lippi et al suggested monitoring haemoglobin levels to detect poor prognosis, more exploratory studies are needed on this aspect.[21] Haematological indices of COVID-19 patients are important to find out secondary infection and immunological stage of the patients.

In present study patients in the severe group had more co-morbidity, like diabetes, hypertension and hypothyroidism. In some other studies higher morbidity and mortality have been reported among patients with co-morbid conditions.

Infection-related biomarkers, like PCT and CRP have been recorded in our study; an increase in CRP was recorded in 63.6% of total cases whereas 83.3% of cases admitted in the ICU. Similar findings were reported in other studies so we can say PCT and CRP is excellent predictor of inflammation of tissues and organs.[22-24]

Increased PCT and CRP is important marker of prognosis in COVID-19 patients and can be used to predict the severity of the disease, which reflects the persistent state of inflammation of different organs (lung, heart, kidney and liver).[25]

Increased serum PCT and CRP helps for further investigation of vital organ function test for diagnosis of acute respiratory distress syndrome (ARDS), acute renal injury, acute heart injury and decreased liver function.[26]

Apart from serum PCT and CRP, serum ferritin and D-dimer levels have been established to be higher in severe cases of corona virus disease (COVID-19) than those with mild clinical features.[27-29]

### *Limitations*

The D-dimer test and serial monitoring of laboratory investigations could not be performed. The specific chest x-ray and CT-scan findings could not be documented and analysed.

## CONCLUSION

Management of symptomatic COVID-19 patient was a big task for health care sector. Based on statistical analysis of the present study, we concluded that novel corona virus not only affecting respiratory system but also other vital organs. On the basis of haematological and biochemical findings we can predict the severity of COVID-19 infection. The present study also analyses that liver and kidney dysfunction occurred more in diabetes and hypothyroidism COVID-19 patients. Despite the limitations of the study, the analysis of the study will be helpful for the treatment of COVID-19 patients.

## ACKNOWLEDGEMENTS

I am grateful to all of those with whom I have had the pleasure to work during this research work. Each of the members of my work has provided me extensive personal and professional guidance and taught me a great deal about scientific research. I would especially like to thank Dr. P. K. Singh, the Principal/Dean of Rama Medical College and Research Centre, Kanpur, UP.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. World Health Organization. Coronavirus disease (COVID-19) Pandemic, WHO.Accessed from https://www.who.int/emergencies/diseases/novel-coronavirus-2019. Accessed on 31 March 2020.

2. Sun P, Lu X, Xu C, Sun W and Pan B. Understanding of COVID-19 Based on CurrentEvidence Journal of Medical Virol. 2020;92(6):548-51.
3. Seidel EJ, Mohlman J, Basch CH, Fera J, Cosgrove A, Ethan D. Communicating Mental Health Support to College Students During COVID-19: An Exploration of Website Messaging Journal of Community Health.2020;1-4.
4. Woo PC, Lau SK, Huang Y, Yuen KY. Coronavirus diversity, phylogeny and interspecies jumping, Exp. Biol. Med. (Maywood). 2009;234(10):1117-27.
5. Schoeman BC. Fielding, Coronavirus envelope protein: current knowledge. Virol J. 2019;16(1):69.
6. Hui DS. An overview on severe acute respiratory syndrome (SARS). Monaldi Arch Chest Dis. 2005;63(3):149-57.
7. Bohn MK, Lippi G, Horvath A, Sethi S, Koch D, Ferrari M, et al. Molecular, serological, and biochemical diagnosis and monitoring of COVID-19: IFCC taskforce evaluation of the latest evidence. ClinChem Lab Med. 2020;58(7):1037-52.
8. Letelieret P. Role Of Biochemical Markers In The Monitoring Of Covid-19 Patients. J Med Biochem. 2021;40:115-28.
9. Sproston NR, Ashworth JJ. Role of C-reactive proteinat sites of inflammation and infection. Front Immunol. 2018;13(9):754.
10. Patel C. A study of the clinico-epidemiological profile of covid-19 patients admitted in a tertiary care hospital in India. Journal of Clinical and Diagnostic Research. 2021;15(4):9-13.
11. Hasan MJ, Chowdhury SM, Khan MA, Rahaman M, Fardous J, Adit T et al. Clinico-epidemiological characteristics of asymptomatic and symptomatic COVID-19-positive patients in Bangladesh. medRxiv. 2020.
12. Bhandari S, Singh A, Sharma R, Rankawat G, Banerjee S, Gupta V, et al. Characteristics, treatment outcomes and role of hydroxychloroquine among 522 COVID-19 hospitalized patients in Jaipur city: An epidemio-clinical study. J Assoc Physicians India. 2020;68(6):13-9.
13. Gupta N, Agrawal S, Ish P, Mishra S, Gaind R, Usha G, et al. Safdarjung Hospital COVID 2019 working group. Clinical and epidemiologic profile of the initial COVID-19 patients at a tertiary care centre in India. Monaldi Archives for Chest Disease. 2020;90(1):32290644.
14. Aggarwal A, Shrivastava A, Kumar A, Ali A. Clinical and epidemiological features of SARS-CoV-2 patients in SARI ward of a tertiary care centre in New Delhi. Journal of The Association of Physicians of India. 2020;68(7):19-26.
15. Chen N. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet.2020;395:507-13.
16. Fan BE, Chong VCL, Chan SSW, Lim GH, Lim KGE, Tan GB et al. Hematologic parameters in patients with COVID-19 infection.Am J Hematol. 2020;95:E131-34.
17. Rahmanet A. Hematological Abnormalities in COVID-19: A Narrative Review. Am J Trop Med Hyg. 2021;104(4):1188-201.
18. Liu W, Li H. COVID-19: attacks the 1-beta chain of haemoglobin and captures the porphyrin to inhibit human heme metabolism. ChemRxiv. 2020.
19. Wan S. Clinical features and treatment of COVID-19 patients in northeast Chongqing. J Med Virol. 2020;92:797-806.
20. Wang Z, Yang B, Li Q, Wen L, Zhang R. Clinical features of 69 cases with coronavirus disease 2019 in Wuhan, China. Clin Infect Dis. 2020;71:769-77.
21. Lippi G, Mattiuzzi C. Hemoglobin value may be decreased in patients with severe coronavirus disease 2019. Hematol Transfus Cell Ther. 2020;42:116-17.
22. XM Luo, Zhou W, Yan XJ, Guo TG, Wang BC. Prognostic value of C-reactive protein in patients with COVID-19. Clin Infect Dis. 2020;71:2174-9.
23. Guo T, Fan Y, Chen M, Wu X, Zhang L. Cardiovascular Implications of Fatal Outcomes of Patients With Coronavirus Disease 2019 (COVID-19). JAMA Cardiol. 2019;5:811-8.
24. Li L, Li S, Xu MM, Zheng SJ, Duan ZP. Risk factors related to hepatic injury in patients with corona virus disease 2019. medRXIV. 2019.
25. Lu JT, Hu SF, Fan R, Liu ZH, Yin XR. ACP risk grade: A simple mortality index for patients with confirmed or suspected severe acute respiratory syndrome coronavirus 2 disease (COVID-19) during the early stage of outbreak in Wuhan, China. medRXIV. 2019.
26. Li Y, Zhang HT, Xiao Y, Wang ML, Guo YQ. Prediction of criticality in patients with severe Covid-19infection using three clinical features: A machine learning-based prognostic modelwith clinical data in Wuhan. medRXIV. 2020.
27. Feng Y, Ling Y, Bai T, Xie Y, Huang J. COVID-19 with different severities: a multicenter study of clinical features. Am J RespirCrit Care Med. 2020;201:1380-8.
28. Zhou F, Yu T, Du R, Fan G, Liu Y, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study. Lancet. 2020;395:1054-62.
29. Wu C, Chen X, Cai Y, Xia J, Zhou X. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med. 2020;180:1-11.
30. Guidelines on Clinical Management of COVID-19. Available at: https://www. mohfw.gov.in/pdf/GuidelinesonClinicalManagementofCOVID1912020.pdf. Accessed on 29 December 2020.


**Cite this article as:** Kumar S, Pankaj P, Singh N, Narang A, Anand P, Singh DN. Clinico-pathological changes in COVID-19 patients. Int J Adv Med 2021;8:1841-5.