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Mortality association with Clinical Laboratory Parameters in the Elderly COVID-19 Patients

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Abstract

Background: Data suggests that the elderly are more vulnerable to coronavirus disease 2019.

Objectives: The primary objectives were (i) to characterise the clinical profile and the routine laboratory parameters in the elderly COVID-19 and to correlate with mortality, (ii) to compare the routine laboratory parameters and the outcomes between the elderly COVID-19 patients with the non-elderly COVID-19 patients. The secondary objective was to compare the routine laboratory parameters and outcomes between the elderly COVID-19 patients having any comorbidity with the non-elderly COVID-19 patients having any one or no comorbidity.

Materials and method: In this retrospective study we collected and analysed the demographic and clinical data along with routine laboratory parameters of all patients admitted.

Results: The age of the 31 elderly patients was 70.1±7.1years, with 20/31(64.5%) males, 30/31(96.7%) having at least one comorbidity, 28/31(90.3%) had severe with a death rate of 17/31(54.8%). Haemoglobin(p=0.034), haematocrit(p=0.029), red cell count(p=0.022), total calcium(p=0.008) and albumin(p=0.033) levels were significantly lower, whereas, urea (p=0.008), creatinine(p=0.025) and uric acid levels(p=0.022) were significantly higher in the non-survivors than the survivors. Comorbidities were

significantly higher in the elderly group than the non-elderly group(p=0.002). Also, the levels of urea(p<0.001), creatinine(p<0.001) and uric acid (p=0.039) were significantly higher in the elderly group than in the non-elderly COVID-19 positive population. The requirement of ventilator support (p=0.002) and mortality rate(p<0.001) were significantly higher in the elderly.Significant differences were observed in haemoglobin(p=0.031), haematocrit(p=0.039), total leucocyte count (p=0.024), absolute neutrophil count(p=0.004), neutrophil-lymphocyte ratio(p<0.001), lymphocyte-monocyte ratio(p=0.002), urea(p<0.001), creatinine(p=0.001), uric acid(p=0.003) and albumin(p=0.033) between elderly COVID-19 patients having any comorbidity with the non-elderly COVID-19 patients having any one or no comorbidity.

Conclusion: High mortality rate is observed in the elderly with COVID-19 disease. Presence of anaemia, poor renal function and hypoalbuminemia are important findings at admission which are associated with a higher mortality.

Keywords: Corona virus, Geriatric, Laboratory Medicine, Public health; SARS-CoV-2

Introduction

The viral outbreak of coronavirus disease 2019 (COVID-19) has become a major public health concern ever since its recognition in Wuhan, China in December 2019. In India, by September 21, 2020, more than 5.4 million people have been reported to be infected by the disease with a mortality of 79,754. [1] Data suggests that the elderly population is more vulnerable than the middle-aged and the young.[2–5] It is noteworthy that, India is a densely populated country with a population size of 1380 million where elderly account for 8.8% of the total.[6] A recent study from India estimates the trends of COVID- 19 in the older people (COPE) and suggests that they are more prone to infection and have a higher chance of death. [7] Lethality in COPE has been explained by the Hyperfunction Theory of Quasi-programmed Aging, exaggerated by other age-related comorbidities. [8]

Research concerning COPE has largely focussed on the clinical features and treatment measures as predictors for the outcome. There is limited information describing the association of the routine laboratory parameters withoutcomes in the Indian elderly patients requiring hospitalization for COVID-19. The two primary objectives were (i) to characterise the clinical profile and the routine laboratory parameters in the elderly COVID-19 and to correlate with mortality, (ii) to compare the routine laboratory parameters and the outcomes between the elderly COVID-19 patients with the non-elderly COVID-19 patients. The secondary objective was to compare the routine laboratory parameters and the outcomes between the elderly COVID-19 patients having any comorbidity with the non-elderly COVID-19 patients having any one or no comorbidity.

Materials and Method

In this retrospective study,we included consecutive patients hospitalised with laboratory confirmed diagnosis of COVID-19 in our hospital which is a tertiary care centre in North India.Our centre was designated as a referral facility for COVID-19 patients from nodal public sector hospitals catering to COVID-19 patients acrossall severity spectra, as per government policy. All enrolled patients were diagnosed according to Interim guidelines for novel coronavirus pneumonia publishedby the World Health Organisation andDirectorate General of Health Services, Delhi State. [9,10]We collected demographic and clinical data along with routine laboratory

parameters of all patients admitted from March 23 to April 30, 2020. We dichotomized our patient population into elderly (defined as >60 years of age) and non-elderly (≤60 years). Severity of COVID-19 was classified in all patients as mild (without pneumonia), moderate (with pneumonia) or severe (RR >24/min, SpO2 <94% on room air, confusion, drowsiness, hypotension, sepsis, septic shock). Laboratory parameters on the first day of admission were compared between the two groups. The parameters recorded include complete blood count, coagulation tests, and liverand renal function tests.The outcomes of the study were disease severity, requirement of ventilator support and mortality.

Statistical analysis

The demographic and other characteristics of the study participants were summarized using means and standard deviation or median with range for quantitative variables as appropriate, andfrequency (percentages) for qualitative variables. Student t -test and Mann–Whitney U test were used as per the distribution (normal or non-normal) for analysis of quantitative variables. Chi-square test or Fisher exact test, as appropriate, were used to analyse the categorical variables. To compare quantitative variables between three groups, one way ANOVA followed by post hoc Bonferroni test, if required, was used. Stata software, version 15.1 was used for analysis, and pvalue<0.05 was considered statistically significant.

Results

Characteristics of the elderly COVID-19 positive patients

Of the total 161 patients, 31(19.2%) patients were elderly. Mean age of elderly group was 70.1±7.1years, with 20/31(64.5%) males(Table1).At least one comorbidity was present in 30/31 (96.7%) patients, with 17/31(54.8%) being hypertensive and 14/31(45.1%) havingdiabetes.

Laboratory parameters of the elderlyCOVID-19 positive patients

The haematology, the coagulation and the biochemistry profile of the elderly patients within 24 hours of admission are shown in Table 2. The mean haemoglobin level was 10.8±2.2g/dL with 23/31(74.1%) being anaemic. The median total leukocyte count and themedian platelet count were 10.6(4.9-26.5) $X10^3$cells/mm^3 and 181(53-413) $X10^3$/mm^3, respectively. Lymphopenia was seen in 6/31(19.3%) patients. Mean neutrophil-lymphocyte ratio was 2.8(0.8-9).The prothrombin time was raised in 9/31(29.0%)and the activated partialthromboplastin time was raised in 3/31(9.6%) patients.Hyperuremia, hypercreatininemia and hyperuricemia were observed in 18/31(58.0%), 15/31(48.3%) and 12/31(38.7%) elderly patients, respectively. Hypoalbuminemia was observed in 30/31(96.7%) patients.

Outcomes of the elderly COVID-19 positive patients

Of all, 28/31 (90.3%) had severe disease and 17/31(54.8%) required ventilator support during the hospital stay. The death rate was 17/31(54.8%) in the elderly group. On comparing the survivors with the non-survivors shown in Table 3, haemoglobin (p=0.034), haematocrit (p=0.029), red cell count (p=0.022), total calcium (p=0.008) and albumin (p=0.033) levels were significantly lower, whereas, urea (p=0.008), creatinine (p=0.025) and uric acid levels (p=0.022) were significantly higher in the non-survivors than the survivors.

Comparison of the elderly with the non-elderly COVID-19 positive population

Comparison of the clinical and laboratory parameters of the elderly with the non-elderly population are shown

in Tables 1 and 3. Comorbidities were significantly higher in the elderly group than the non-elderly group (p=0.002). Also, the levels of urea (p<0.001), creatinine (p<0.001) and uric acid (p=0.039) were significantly higher in the elderly group than in the non-elderly COVID-19 positive population. The requirement of ventilator support (p=0.002) and mortality rate (p<0.001) were significantly higher in the elderly.

Impact of comorbidities in the elderly and non-elderly COVID-19 positive patients

Table 4 demonstrates the comparison of clinical characteristics, the routine laboratory parameters and outcomes between the elderlyCOVID-19 patients having at least one comorbidityand the non-elderly with and without at least one pre-existing comorbidities. The need for ventilator support and mortality were highest amongst the elderly having at least one comorbidity than in the non-elderly COVID-19 positive with or without comorbidities (p <0.001 for both). Significant differences were observed in the levels of haemoglobin (p=0.031), haematocrit (p=0.039), total leucocyte count (p=0.024), absolute neutrophil count (p=0.004), neutrophil-lymphocyte ratio (p<0.001), lymphocyte-monocyte ratio (p=0.002), urea (p<0.001), creatinine (p=0.001), uric acid (p=0.003) and albumin (p=0.033) between the groups.

Discussion

This study represents the first description of the elderly patients admitted to a COVID-19 dedicated tertiary care hospital from north India. The mean age and percentage of higher males being affected in our study were comparable to the previously published reports from other countries. [11–15] Stronger immunity in females against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is postulated to be due to site-specific lack of X chromosome inactivation of the angiotensin-converting enzyme 2 (ACE2) gene, located on the Xp22.2 position. It forms the enzyme coopted by SARS-CoV-2 to enter the epithelial cells. This results in higher availability of unbound ACE2 in females to catalytically cleave Angiotensin II to form Angiotensin 1–7, thus decreasing the proinflammatory background.[16]Almost 90% of elderly patients in our study had severe disease with a lethality above 50%, which is much higher than previously reported. [12,13]Increased risk of serious illness and death due to COVID-19 infection in our elderly population could be because almost all had co-existing comorbidities, the commonest one being hypertension. Literature suggests that mortality increases with increasing age, associated comorbidities and in those requiring ventilator support. [12,17–21]. Our study highlights that the non-elderly population having no comorbidities had less severe disease course and better survival. It has been seen that the COVID-19 elderly patients with hypertension and diabetes, have critically low ACE2 expression, resulting in up-regulation of angiotensin II proinflammatorysignalling,resulting in higher severity of the disease. [22] The changes brought to the immune system by the physiological aging process along with the harsher social & economic factors in the developing countries like ours, may also influence and increase the vulnerability to the disease. [23-26]

Routine parameters are cheap, easy to analyse and easily available in a resource-limited setup. Identifying those biomarkers for COPE that associate with disease severity and mortality may help in prompt patient management. Since COVID-19 has a significant impact on the hematopoietic system, low levels of haemoglobin, red cell count and haematocrit were observed in the elderly COVID-19 patients on the day of admission, similar to the previously reported studies.

[27-30] We also found that the elderly patients havingat least one comorbidity had the highest neutrophil/lymphocyte ratio (NLR) and the lowest lymphocyte-monocyte ratio (LMR)levels at the time of admission. This is in agreement with the existing literature that suggests that lymphopenia, NLR andLMR have prognostic potential. [30,31] Changes like NLR elevation and lymphopenia likely occur due to dysregulated inflammatory cytokine response, an aberrant increase of pathological neutrophil and the upregulation of genes involved in the lymphocyte cell death pathway, caused by COVID-19 infection. [32,33] A decreased LMR value in the elderly with COVID-19 was possibly a result of lymphocyte release from the blood circulation into the pulmonary tissue infiltrate, and to a higher susceptibility of membrane damage with increasing age. [34]

Abnormal coagulation profile associates with poor prognosis in COVID-19 disease. Studies have reported prolonged prothrombin time in the non-survivors. [35,36] Only, a minority of the patients had prolonged coagulation parameters at admission in our set up.

Majority of the elderly patients had abnormal values of urea, creatinine and uric acid at the time of presentation. Corroborative findings have been reported in studies from China.[37,38] Deranged kidney function could be either attributed to the age-related changes in the kidney or due to the associated comorbidities like hypertension or diabetes in renal functions.[39-42] The possibility of either SARS-CoV-2 directly affecting the kidney cells or the damage of the renal cells due to the systemic cytokine storm or hypoxia could also contribute to the deranged kidney function and needs to be further explored.[43]Hypoalbuminemia was observed in the majority of our elderly population and was associated with higher mortality. A similar finding has been reported in a few other COPE studies.[44,45] The possibility of selective proteinuria and correlation with histopathological changes of the kidney may help. We also found the majority of the patients to have a low value of total calcium. This could be due to the fact that 80% of the protein-bound fraction of calcium is bound to albumin. [46] Thus, abnormally low levels of albumin seen in our study population may have resulted in the low value of total calcium. Measuring the levels of ionised calcium could have been more informative.

The inflammatory indices, including LDH, CRP, IL-6, serum procalcitonin and ferritin, are a result of the cytokine storm associated with the disease and are biomarkers to identify cases with poor prognosis.[47,48] But in the developing countries with limited means, evaluation of the routine laboratory parameters can aid in predicting outcomes.

Our study provides some initial experiences regarding the role of routine laboratory parameters and early outcomes amongst older patients with COVID-19 in the Indian scenario. We suggest, assessing the routine laboratory parameters at the time of admission could identify the elderly patients with high risk of mortality and help in risk stratification. Other than age, male gender and presence of comorbidities, anaemia, poor renal function, hypoalbuminemia and hypocalcemiaat the time of presentation are some important biomarkers associated with mortality in older people with COVID-19.

Limitations

The study includes only a small number of patients from a single center. A larger case series is suggested to substantiate the findings further. Also, the results are limited to the in-hospital clinical course only.

Conclusion

High mortality rate is observed in the elderly with COVID-19 disease. Presence of anaemia, poor renal function and hypoalbuminemia are important findingsat admission which are associated with a higher mortality. Assessing day one routine laboratory parameters may help instratifying the elderly patients at higher risk of death.

References

1. COVID19 INDIA. Coronavirus in India: latest map and case count,https://www.covid19india.org, [accessed5 September 2020]
2. Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. Lancet Infect Dis. 2020 Jun;20(6):669–77.
3. Abbatecola AM, Antonelli-Incalzi R. COVID-19 Spiraling of Frailty in Older Italian Patients. J Nutr Health Aging. 2020 Apr 7;1–3. 10.1007/s12603-020-1357-9
4. Gao S, Jiang F, Jin W, Shi Y, Yang L, Xia Y, et al. Risk factors influencing the prognosis of elderly patients infected with COVID-19: a clinical retrospective study in Wuhan, China. Aging. 2020 Jul 11;12(13):12504–16. https://doi.org/10.18632/aging.103631
5. Sciacqua A, Pujia R, Arturi F, Hribal ML, Montalcini T. COVID-19 and elderly: beyond the respiratory drama. Intern Emerg Med. 2020 Aug;15(5):907–9. https://doi.org/10.1007/s11739-020-02424-x
6. India population, https://www.worldometers.info/world-population/india-population/[accessed 5 September 2020]
7. Singh AK, Gupta R, Ghosh A, Misra A. Diabetes in COVID-19: Prevalence, pathophysiology, prognosis and practical considerations. Diabetes Metab Syndr. 2020 Aug;14(4):
8. Blagosklonny MV. From causes of aging to death from COVID-19. Aging (Albany NY). 2020 Jun 15;12(11):10004. https://doi.org/10.18632/aging.103493
9. Directorate General of Health Services (EMR Division), Ministry of Health & Family Welfare, Government of India. Guidance document on appropriate management of suspect/confirmed cases of COVID-19. https://www.mohfw.gov.in/pdf/FinalGuidanceonMangaementofCovidcasesversion2.pdf [accessed 5 September 2020]
10. World Health Organization. Clinical management of COVID-19, https://www.who.int/publicationsdetail-redirect/clinical-management-of-covid-19[accessed 5 September 2020]
11. Liu Y, Mao B, Liang S, Yang J-W, Lu H-W, Chai Y-H, et al. Association between age and clinical characteristics and outcomes of COVID-19. Eur Respir J [Internet]. 2020 May 28;55(5). https://doi.org/10.1183/13993003.01112-2020.
12. Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in elderly patients: A comparison with young and middle-aged patients. J Infect. 2020;80(6):e14–8. https://doi.org/10.1016/j.jinf.2020.03.005
13. Wang L, He W, Yu X, Hu D, Bao M, Liu H, et al. Coronavirus disease 2019 in elderly patients: Characteristics and prognostic factors based on 4-week follow-up. J Infect. 2020;80(6):639–45. https://doi.org/10.1016/j.jinf.2020.03.019

14. Lithander FE, Neumann S, Tenison E, Lloyd K, Welsh TJ, Rodrigues JCL, et al. COVID-19 in older people: a rapid clinical review. Age Ageing. 2020 Jul 1;49(4):501–15. https://doi.org/10.1093/ageing/afaa093.
15. Wu Y, Guo W, Liu H, Qi B, Liang K, Xu H, Peng Z, Xiao SY. Clinical outcomes of 402 patients with COVID-2019 from a single center in Wuhan, China. Journal of Medical Virology. 2020 Jan 1.https://doi.org/10.1002/jmv.26168
16. Li Y, Jerkic M, Slutsky AS, Zhang H. Molecular mechanisms of sex bias differences in COVID-19 mortality. Critical Care. 2020 Dec;24(1):1-6. https://doi.org/10.1186/s13054-020-03118-8
17. Guan WJ et al. Comorbidity and its impact on 1590 patients with Covid-19 in China: A Nationwide Analysis. Eur Respir J 2020 Mar 26; [e-pub]. (https://doi.org/10.1183/13993003.00547-2020)
18. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. JAMA. 2020 May 26;323(20):2052–9. https://doi.org/10.1001/jama.2020.6775
19. Porcheddu R, Serra C, Kelvin D, Kelvin N, Rubino S. Similarity in Case Fatality Rates (CFR) of COVID-19/SARS-COV-2 in Italy and China. J Infect Dev Ctries. 2020 29;14(2):125–8.https://doi.org/10.3855/jidc.12600
20. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, Xiang J, Wang Y, Song B, Gu X, Guan L. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The lancet. 2020 Mar 11.
21. Beales DL, Tulloch AJ. Community care of vulnerable older people: cause for concern. Br J Gen Pract. 2013 Oct;63(615):549–50. https://doi.org/10.3399/bjgp13X673892
22. AlGhatrif M, Cingolani O, Lakatta EG. The dilemma of coronavirus disease 2019, aging, and cardiovascular disease: insights from cardiovascular aging science. JAMA cardiology. 2020 Apr 3.https://doi.org/10.1001/jamacardio.2020.1329
23. Koff WC, Williams MA. Covid-19 and Immunity in Aging Populations — A New Research Agenda. N Engl J Med. 2020 Apr 17;NEJMp2006761. https://doi.org/10.1056/NEJMp2006761.
24. Barbosa KTF, Costa KN de FM, Pontes M de L de F, Batista PS de S, Oliveira FMRL de, Fernandes M das GM. Aging and individual vulnerability: a panorama of older adults attended by the family health strategy. Texto Contexto - Enferm. 2017;26(2). https://doi.org/10.1590/0104-07072017002700015
25. Nagar S, Nagar N, Nagar SS, Mahyawanshi D, Kartha GP. Impact of social factors on health practices of the elderly: an analytical study in rural Surendranagar. Int J Res Med Sci. 2017 Jan 26;1(2):116–22. https://imsear.searo.who.int/handle/123456789/150456
26. Usul E, Şan İ, Bekgöz B, Şahin A. The role of hematological parameters in COVID-19 patients in the emergency room. Biomarkers in Medicine. 2020 Jul(0).https://doi.org/10.2217/bmm-2020-0317
27. Terpos E, Ntanasis-Stathopoulos I, Elalamy I, Kastritis E, Sergentanis TN, Politou M, Psaltopoulou T, Gerotziafas G, Dimopoulos MA.

Hematological findings and complications of COVID-19. American journal of hematology. 2020 Apr 13.https://doi.org/10.1002/ajh.25829

28. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, Liu L, Shan H, Lei CL, Hui DS, Du B. Clinical characteristics of coronavirus disease 2019 in China. New England journal of medicine. 2020 Apr 30;382(18):1708-20.https://doi.org/10.1056/NEJMoa2002032
29. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, Wang B, Xiang H, Cheng Z, Xiong Y, Zhao Y. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. Jama. 2020 Mar 17;323(11):1061-9.https://doi.org/10.1001/jama.2020.1585
30. Liao D, Zhou F, Luo L, Xu M, Wang H, Xia J, Gao Y, Cai L, Wang Z, Yin P, Wang Y. Haematological characteristics and risk factors in the classification and prognosis evaluation of COVID-19: a retrospective cohort study. The Lancet Haematology. 2020 Jul 10.
31. Yang AP, Liu J, Tao W, Li HM. The diagnostic and predictive role of NLR, d-NLR and PLR in COVID-19 patients. International immunopharmacology. 2020 Apr 13:106504.https://doi.org/10.1016/j.intimp.2020.106504
32. Liu J, Liu Y, Xiang P, Pu L, Xiong H, Li C, Zhang M, Tan J, Xu Y, Song R, Song M. Neutrophil-to-lymphocyte ratio predicts critical illness patients with 2019 coronavirus disease in the early stage. Journal of Translational Medicine. 2020 Dec;18:1-2. https://doi.org/10.1101/2020.02.10.20021584
33. yan Q, Li P, Ye X, et al. Longitudinal peripheral blood transcriptional analysis of COVID-19 patients captures disease progression and reveals potential biomarkers. medRxiv. 2020. https://doi.org/10.1101/2020.05.05.20091355
34. Lissoni P, Rovelli F, Monzon A, Privitera C, Messina G, Porro G. Evidence of Abnormally Low Lymphocyte-To-Monocyte Ratio In Covid-19-Induced Severe Acute Respiratory Syndrome. J Immuno Allerg. 2020;1(2):1-6. https://doi.org/10.37191/Mapsci-2582-6549-1(2)-011
35. Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. Journal of thrombosis and haemostasis. 2020 Apr;18(4):844-7.https://doi.org/10.1111/jth.14768
36. Gao S, Jiang F, Jin W, Shi Y, Yang L, Xia Y, Jia L, Wang B, Lin H, Cai Y, Xia Z. Risk factors influencing the prognosis of elderly patients infected with COVID-19: a clinical retrospective study in Wuhan, China. Aging (Albany NY). 2020 Jul 15;12(13):12504.https://doi.org/10.18632/aging.103631
37. Xiang J, Wen J, Yuan X, Xiong S, Zhou X, Liu C, Min X. Potential biochemical markers to identify severe cases among COVID-19 patients. medRxiv. 2020 Jan 1. https://doi.org/10.1101/2020.03.19.20034447
38. Cao J, Tu WJ, Cheng W, Yu L, Liu YK, Hu X, Liu Q. Clinical features and short-term outcomes of 102 patients with corona virus disease 2019 in Wuhan, China. Clinical Infectious Diseases. 2020 Apr 2. https://doi.org/10.1093/cid/ciaa243
39. Denic A, Glassock RJ, Rule AD. Structural and functional changes with the aging kidney. Adv

Chronic Kidney Dis. 2016 Jan;23(1):19–28. https://doi.org/10.1053/j.ackd.2015.08.004

40. Abdel-Rahman EM, Okusa MD. Effects of Aging on Renal Function and Regenerative Capacity. Nephron Clin Pract. 2014;127(1–4):15–20. https://doi.org/10.1159/000363708
41. Bakris GL. Protecting renal function in the hypertensive patient: clinical guidelines. American journal of hypertension. 2005 Apr 1;18(S3):112S-9S.https://doi.org/10.1016/j.amjhyper.2004.11.046
42. Wang Y, Zhong B, Li Y, Qin X, Wang B, Xu X, Hou F, Huo Y, Xu X. Relationship of diabetes with renal dysfunction in hypertensive adults. Medicine. 2017 Jun;96(24).https://doi.org/10.1097/MD.0000000000007169
43. Farouk SS, Fiaccadori E, Cravedi P, Campbell KN. COVID-19 and the kidney: what we think we know so far and what we don't. Journal of nephrology. 2020 Jul 20:1-6.https://doi.org/10.1007/s40620-020-00789-y
44. Ponti G, Maccaferri M, Ruini C, Tomasi A, Ozben T. Biomarkers associated with COVID-19 disease progression. Critical Reviews in Clinical Laboratory Sciences. 2020 Jun 3:1-1.https://doi.org/10.1080/10408363.2020.1770685
45. Liu Y, Yang Y, Zhang C, Huang F, Wang F, Yuan J, Wang Z, Li J, Li J, Feng C, Zhang Z. Clinical and biochemical indexes from 2019-nCoV infected patients linked to viral loads and lung injury. Science China Life Sciences. 2020 Mar;63(3):364-74.https://doi.org/10.1007/s11427-020-1643-8
46. Clase CM, Norman GL, Beecroft ML, Churchill DN. Albumin-corrected calcium and ionized calcium in stable haemodialysis patients. Nephrology Dialysis Transplantation. 2000 Nov 1;15(11):1841-6. https://doi.org/10.1093/ndt/15.11.1841.
47. Henry BM, De Oliveira MH, Benoit S, Plebani M, Lippi G. Hematologic, biochemical and immune biomarker abnormalities associated with severe illness and mortality in coronavirus disease 2019 (COVID-19): a meta-analysis. Clinical Chemistry and Laboratory Medicine (CCLM). 2020 Jun 25;58(7):1021-8.https://doi.org/10.1515/cclm-2020-0369
48. Zhou B, She J, Wang Y, Ma X. Utility of ferritin, procalcitonin, and C-reactive protein in severe patients with 2019 novel coronavirus disease. https://doi.org/10.21203/rs.3.rs-18079/v1

Legend Tables

Table1: Comparison of patient demographics and outcomes between the elderly and non-elderly COVID-19 positive population

Patient Characteristics	Elderly (N=31)	Non -elderly (N=130)	p value
Age (years)	70.1±7.1	41.9±14.6	---
Males	20 (64.5)	89 (68.4)	0.673
Patients with at least one comorbidity	30 (96.7)	94 (72.3)	0.002
• Hypertension • Diabetes • Cardiovascular disease (MI, CAD, RHD, etc) • Chronic kidney disease • Malignancy • Chronic liver disease	17 (54.8) 14 (45.1) 9 (29) 4 (12.9) 3 (9.6) 1 (3.2)	31(23.8) 32 (24.6) 8 (6.1) 14 (10.7) 14 (10.7) 6 (4.6)	---
Outcomes			
Patients requiring ventilator support	17 (54.8)	34 (26.1)	0.002
Patients with of severe disease	28 (90.3)	113 (86.9)	0.767
In-hospital mortality	17 (54.8)	28 (21.5)	<0.001

Continuous data are presented as mean±standard deviation or median(minimum, maximum); categorical data are presented as frequency(%); Abbreviation: COVID-19, Coronavirus disease-2019; MI, Myocardial infarction; CAD, Coronary Artery Disease; RHD, Rheumatic Heart Disease

Table 2: Comparison of the routine laboratory parameters between the elderly and the non-elderly COVID-19 positive population

Laboratory Parameters	Elderly (N=31)	Non -elderly (N=130)	p value
Complete blood count			
Haemoglobin (g/dL)	10.8±2.2	10.7±2.7	0.853
Anaemia (Haemoglobin <12.5g/dL)	23 (74.1)	91 (70)	0.491
Haematocrit (%)	32.8±7.6	32.5±7.9	0.868
Red blood cell count (X 10^6 cells/cumm)	3.8±0.9	3.7±0.9	0.453
Total leukocyte count (X10^3 cells/cumm)	10.6(4.9,26.5)	8.1(1.1,71.5)	0.058
Leucocytosis (>1.1 X10^3 cells/cumm)	13 (41.9)	35 (26.9)	0.063
Neutrophil: Lymphocyte (NLR)	2.8(0.8-9)	2.3(0.3-75)	0.125
>3.2 NLR	12 (38.7)	43 (33.0)	---
Platelet count (X10^3 cells/cumm)	181(53,413)	160(13,603)	0.298

Thrombocytopenia (<150 X10^3 cells/cumm)	10 (32.2%)	56(43.0)	0.27
Coagulation profile			
Prothrombin time (PT) (seconds)	13(11.9,90)	15.25(10.4,90)	0.392
Prolonged PT	9 (29.0)	27 (20.7)	0.60
International Normalised Ratio	1.1(0-1.98)	1.1(0-6.1)	0.315
Activated Partial Thromboplastin Time (aPTT) (seconds)	30.1(20,140)	31.2(20,140)	0.929
Prolonged aPTT	3 (9.6)	22 (16.9)	0.171
Kidney function test			
Urea (mg/dL)	60(17,233)	32(6,286)	<0.001
Hyperuremia	18 (58.0)	36 (27.6)	0.001
Creatinine (mg/dL)	1.2(0.4,13.5)	0.7(0.1,18.6)	<0.001
Hypercreatinemia	15 (48.3)	27 (20.7)	0.002
Calcium (mg/dL)	8.1±0.8	8.0±0.9	0.603
Hypocalcemia	15 (48.3)	61 (46.9)	0.883
Phosphate (mg/dL)	3.7(1.6,11.9)	3.5(1.4,12.9)	0.882
Hypophosphatemia	8 (25.8)	27 (20.7)	0.815
Hyperphosphatemia	8 (25.8)	38 (29.2)	
Uric acid (mg/dL)	7(2.1,22.3)	4.3(1.3,26.2)	0.004
Hypouricemia	0 (0)	5 (3.8)	0.039
Hyperuricemia	12(38.7)	23 (17.6)	
Liver function test			
Total bilirubin (mg/dL)	0.8(0.2,2.6)	0.75(0.2,19.7)	0.946
Hyperbilirubinemia	10 (32.2)	37 (28.4)	0.676
Total protein (g/dL)	6.0±0.7	6.2±1.1	0.375
Hypoproteinemia	9 (29.0)	50 (38.4)	0.328
Albumin (g/dL)	2.6±0.5	2.7±0.7	0.395
Hypoalbuminemia	30 (96.7)	120 (92.3)	0.692
Globulin (g/dL)	3.4±0.6	3.4±0.7	0.680
Albumin: globulin	0.7±0.2	0.8±0.2	0.671
Aspartate transaminase (IU/L)	48(12,181)	45(8.1,1800)	0.777
High aspartate transaminase	18 (58.0)	70 (53.8)	0.970
Alanine transaminase (IU/L)	29(6,142)	34(3,1861)	0.305
High alanine transaminase	11 (35.4)	50 (38.4)	0.759
Alkaline phosphatase (IU/L)	80(28,150)	71(28,888)	0.084
High alkaline phosphatase	3 (9.6)	30 (23.0)	0.137

Electrolytes			
Sodium (meq/L)	137.3±6.6	135.1±12.1	0.333
Hyponatremia	11 (35.4)	50 (38.4)	0.387
Hypernatremia	3 (9.6)	5 (3.8)	
Potassium (meq/L)	4.4±0.9	4.3±0.8	0.458
Hypokalemia	28 (90.3)	113 (86.9)	0.606
Hyperkalemia	0 (0)	10 (7.6)	

Continuous data are presented as mean±standard deviation (SD) or median(minimum, maximum); categorical data are presented as frequency(%); Abbreviation: COVID-19, Coronavirus disease-2019

Table 3: Comparison of COVID-19 elderly patients based on mortality

Characteristics	Survivors (N-=14)	Non-survivors (N=17)	p value
Age (years)	69.0±7.1	71.0±7.1	0.449
Complete blood count			
Haemoglobin (g/dL)	11.7±1.8	10.0±2.3	0.034
Haematocrit (%)	35.9±5.0	30.2±8.5	0.029
Red blood cell count ($X\ 10^6$ cells/cumm)	4.3±0.6	3.5±1.0	0.022
Total leukocyte count ($X10^3$ cells/cumm)	7.8(4.9,26.5)	12.2(4.9,26.0)	0.336
Platelet count ($X10^3$ cells/cumm)	228.5±97.1	166.7±85.6	0.070
Coagulation profile			
Prothrombin time (seconds)	15.4(12,20)	15.2(11.9,90)	0.539
International Normalised Ratio	1.2±0.2	1.1±0.4	0.830
Activated Partial Thromboplastin Time (seconds)	30.9(20,38.8)	29(20,140)	0.630
Kidney function test			
Urea (mg/dL)	45(17,126)	111 (49,233)	0.008
Creatinine (mg/dL)	1(0.4,2)	2.7(0.7,13)	0.025
Calcium (mg/dL)	8.6±0.8	7.8±0.7	0.008
Phosphate (mg/dL)	2.8(1.6,11.9)	4(2.6,11.7)	0.249

Uric acid (mg/dL)	5.9(2.1,8.7)	7.6(2.3,22.3)	0.022
Liver function test			
Total bilirubin (mg/dL)	0.7(0.5,1.3)	0.9(0.2,2.6)	0.950
Total protein (g/dL)	6.2±0.5	5.8±0.9	0.213
Albumin g/dL)	2.8±0.5	2.4±0.5	0.033
Globulin (g/dL)	3.3±0.3	3.4±0.8	0.679
Aspartate transaminase (IU/L)	28(23-121)	58.5(12,181)	0.300
Alanine transaminase (IU/L)	35.5(16,115)	31(6,142)	0.935
Alkaline phosphatase (IU/L)	71(50,262)	65(32,148)	0.286
Electrolytes			
Sodium (meq/L)	137.5±4.7	137.2±8.3	0.909
Potassium (meq/L)	4.4±0.9	4.4±0.9	0.798

Continuous data are presented as mean±standard deviation or median(minimum, maximum); categorical data are presented as frequency(%); Abbreviation: COVID-19, Coronavirus disease-2019

Table 4: Effect of presence of comorbidities on the outcomes and the routine laboratory parameters in elderly and non-elderly COVID positive patients

Patient Characteristics	Elderly with at least one comorbidity (Category I)	Non -elderly		Overall p value	p value between groups
		with at least one comorbidity (Category II)	with nocomorbidity (Category III)		
N	30	93	37	---	---
Age (years)	69.8±7.01	43.3±14.5	38.3±14.5	---	---
Males	19 (63.3)	61 (65.5)	28(75.6)	0.468	---
Outcomes					
Requiring ventilator support	17 (56.6)	28 (30.1)	6 (16.2)	<0.001	---
Severe cases	27 (90.0)	85 (91.4)	28 (75.6)	0.068	---
In-hospital Mortality	17 (56.6)	26 (27.9)	2 (5.4)	<0.001	---
Complete blood count					
Haemoglobin (g/dL)	10.7±2.3	10.2± 2.8	11.8±2.0	0.031	I v/s II: 0.341 1v/s III: 0.008 II v/s III: 1.000
Haematocrit (%)	32.7 ±7.7	31.2 ±8.3	35.9± 5.7	0.039	I v/s II: 1.000 1v/s III: 0.295

					II v/s III:0.006
Red blood cell count (X 10^6 cells/cumm)	3.8± 1.0	3.5± 1.0	4.0± 0.7	0.028	I v/s II: 0.435 1v/s III: 1.000 II v/s III:0.033
Total leukocyte count ($X10^3$ cells/cumm)	10.4(1.4,26.5)	9.6(1.1,52.1)	7.5(2.2,71.5)	0.024	I v/s II: 0.273 1v/s III: 0.005 II v/s III:0.047
Leucocytosis (>1.1 $X10^3$cells/cumm)	12 (40.0)	30 (32.2)	5 (13.5)	0.044	---
Absolute neutrophil count ($X10^3$ cells/cumm)	7.3(2.8,21.7)	5.6(0.2,27.0)	3.9(1.0,44.3)	0.004	I v/s II: 0.528 1v/s III: 0.003 II v/s III:0.004
Neutrophil: Lymphocyte	2.7 (0.8,9)	2.7(0.3,14.1)	1.6 (0.4,75)	<0.001	I v/s II: 0.8115 1v/s III: <0.001 II v/s III:<0.001
Lymphocyte: Monocyte	3.3(1,24)	4.2(0.5,23.5)	6.6 (0.8,22.5)	0.002	I v/s II: 0.540 1v/s III: 0.004 II v/s III: 0.001
Platelet count ($X10^3$ cells/cumm)	183(53,413)	157(26,603)	169(13,444)	0.384	---
Coagulation profile					
Prothrombin time (seconds)	15.8(11.9,90)	15.3(10.4,90)	14.7(10.4,78.2)	0.504	---
Activated Partial Thromboplastin Time (seconds)	30.1(20,140)	31.2 (20,140)	30.6(22.2,78.3)	0.567	---
Kidney function test					
Urea (mg/dL)	62(17,233)	35(6,286)	26(19,137)	<0.001	I v/s II: 0.007 1v/s III: <0.001 II v/s III:0.001
Hyperuremia	18(60.0)	31(33.3)	5(13.5)	<0.001	---
Creatinine (mg/dL)	1.25(0.4,13.5)	0.7(0.1,18.6)	0.8(0.3,9.8)	0.001	I v/s II: 0.003 1v/s III: 0.593 II v/s III: 0.593
Hypercreatinemia	15(50.0)	25(26.8)	2(5.4)	<0.001	---

Calcium (mg/dL)	8.1±0.8	8.0±0.9	8.3±0.6	0.144	---
Hypocalcemia	15(50.0)	38(40.8)	23(62.1)	0.086	---
Phosphate (mg/dL)	4.4±2.6	4.2±2.4	3.9±1.9	0.941	---
Uric acid (mg/dL)	7.3±4.2	5.5±3.6	4.4±1.6	0.003	I v/s II: 0.014 1v/s III: <0.001 II v/s III: 0.206
Hypouricemia	0(0.0%)	3(3.2)	2(5.4)	0.014	----
Hyperuricemia	18 (60.0%)	69(74.1)	33(89.1)		----
Liver function test					
Total bilirubin (mg/dL)	0.8(0.2,2.6)	0.7(0.2,19.7)	0.8(0.3,4.6)	0.963	---
Total protein (g/dL)	6.0±0.7	6.1±1.1	6.3±1.0	0.217	---
Albumin (g/dL)	2.6±0.5	2.6±0.6	2.9±0.8	0.033	I v/s II: 1.000 1v/s III: 0.130 2 v/s 3: 0.037
Hypoalbuminemia	29(96.6)	88(94.6)	32(86.4)	0.177	---
Globulin (g/dL)	3.4±0.6	3.5±0.8	3.3±0.7	0.615	---
Aspartate transaminase (IU/L)	49(12,181)	47(10,1800)	43(8.1,654)	0.747	---
Alanine transaminase (IU/L)	27(6,142)	34(3,1861)	34(10, 282)	0.511	---
Alkaline phosphatase (IU/L)	70.5(32,262)	79(28,888)	91(3,429)	0.195	---
Electrolytes					
Sodium (meq/L)	137.2±6.7	135.0±14.1	135.2±4.7	0.674	---
Potassium (meq/L)	4.4±0.9	4.2±0.9	4.4±0.6	0.585	---

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