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SPECTRUM OF ECHOCARDIOGRAPHIC FINDINGS IN PATIENTS WITH SEVERE AND CRITICAL COVID-19: A SINGLE CENTER EXPERIENCE

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ABSTRACT

Introduction: *Information on the cardiac manifestations of coronavirus disease 2019 (COVID-19) is scarce. In this study we assessed the echocardiogram of consecutive patients with COVID-19 infection to assess the frequency of cardiac abnormalities.*

Materials and Methods: *This retrospective descriptive study examined the echocardiographic study of 43 patients with severe and critical COVID-19 infection admitted at the ICU of Chitwan Medical College from May 16, 2021 to June 05, 2021. The study focused on left ventricle (LV) and right ventricle (RV) function. The results were then compared between severe and critical infections to examine if any differences exist between them.*

Result: *The mean age of the study population was 54 years and predominately males. One-third were classified as critical COVID-19 while the remaining were severe COVID-19. Majority(83.7%) had a normal echocardiogram. Among the patients with abnormal reports, the distribution of echocardiographic pattern were biventricular dilation with biventricular dysfunction in two patients (4.6%), LV dialtion with LV dysfunction in two patients (4.6%) and isolated LV dysfunction (diastolic and systolic) in three patients (6.9%). None of the echocardiographic parameters were significantly different between the severe and the critical infection.*

Conclusion: *COVID-19 in primarily a respiratory disease and the cardiac complications is largely attributed to the critical nature of the illness than the specific infection. Considering the risk of infection spread, routine echocardiography for all patients with COVID-19 infection is not advisable.*

Keywords: *COVID-19; Echocardiography; Left ventricular ejection fraction; Right ventricle assessment.*

INTRODUCTION

The spectrum of COVID-19 infection ranges from mild, self-limiting respiratory tract illness to severe progressive pneumonia, multi-organ failure, and death. Reports have suggested that cardiac complications not only are common in COVID-19 infection but also are associated with increased mortality.[1] Cardiac injury was considered an uncommon contributor to complication in patient with COVID-19 infection. Earlier studies have shown that cardiac injury contributes to about 20% of mortality.[2] In those reports, cardiac complications were defined according to clinical and laboratory parameters (troponin levels), without any systematic cardiac imaging.[3] Although, these laboratory findings are consistent with cardiac injury, there are other conditions which can give a similar results.[4,5] Transthoracic echocardiography is the mainstay of cardiac imaging, used to diagnose different causes of heart failure and to assist in patient hemodynamic evaluation, risk assessment, and therapy

of patients hospitalized in intensive care units.[6,7] However, systematic echocardiographic evaluation of COVID-19 patients has not been routinely performed perhaps because of the logistical problems involved (ie, related to risk of infection spreading). For this study we studied the echocardiographic evaluation of consecutive patients with COVID-19 infection requiring intensive care admission to describe the frequency and spectrum of cardiac abnormalities.

MATERIAL AND METHODS

This retrospective cross-sectional study included all patients with positive PCR test admitted at COVID-19 ICU of Chitwan Medical College- Teaching Hospital classified as severe or critical COVID-19 (WHO classification)[8] from May 16, 2021 to June 05, 2021. This included both males and females 18 years and above. Patients with mild and moderate infections and in whom echocardiogram was unavailable were excluded form the study. All data of patients with severe and critical COVID-19 who underwent comprehensive transthoracic echocardiography were collected. The following measures were undertaken to minimize the risk of infection while performing the echocardiogram: (1) All echocardiographic studies were bedside studies performed at the designated COVID-19 intensive care units. (2) All echocardiographic examinations were performed with the same small dedicated scanners because of the ease of disinfection (3) This echocardiographic scanners was set aside for COVID-19 ICU to minimize the risk of infection spread. (4) Personal protection at the time of echocardiographic recordings included airborne precautions, made up of N-95 respirator masks, fluid-resistant gowns, 2 sets of gloves, head covers, eye shields, and shoe covers.

Left ventricular (LV) diameters and wall thickness were measured from the parasternal long axis view. Ejection fraction (LVEF) was measured using the Teicholz or the Simpson's biplane method.[6] Measurements of mitral inflow included the peak early filling (E wave) and late diastolic filling (A wave) velocities and E/A ratio were recorded. Early diastolic mitral septal and lateral annular velocities (e') were measured in the apical 4-chamber view. Average E/e' ratio and tricuspid regurgitation peak velocity were also measured to quantify the LV diastolic function. Left atrial dimensions was calculated with 2-D linear method. From 4-chamber views encompassing the entire right ventricle (RV) linear dimensions were measured. Apart from qualitative grading, RV function was evaluated by tricuspid annular plane systolic excursion (TAPSE) and systolic tricuspid lateral annular velocity (RV S') measured in the apical 4-chamber view.[7]

All data were analyzed using SPSS version 20. Results were presented as mean±SD or frequency and percentages, mean values of continuous data were compared by means of independent t- test and categorical variables were analyzed using Fisher's exact test.

RESULTS

This study included 43 patients with severe or critical covid admitted at the ICU who underwent echocardiographic evaluation. The distribution of the patients according to age group is shown in Table 1. Majority of the patients were at the age of 40 to 59 years (58.1%) followed by >60 years (30.2%) and only five (11.6%) patients were below 40 years of age. Among the study subjects, 27 (62.7%) were males and 16 (37.2%) were females.

Table 1: Echocardiographic characteristics of the total study population

Variables	Total Patients studied (n = 43)
Age (years), mean ± SD	54.1 ± 12.7
≤39	5 (11.6)
40-59	25 (58.1)
≥60	13 (30.23)
Gender, n (%)	
Male	27 (62.7)
Female	16 (37.2)
LV assessment	
LVESD (mm)	31.6 ± 8
LVEDD (mm)	46.5 ± 5.2
Dilated LV, n (%)	4 (9.3)
Systolic dysfunction, n (%)	5 (11.6)
Diastolic dysfunction, n (%)	6 (13.9)
EF (%)	61 ± 10
E wave, m/s	5.7 ± 1.4
A wave, m/s	7.2 ± 1.7
E/A	0.8 ± 0.3
e' Septal, cm/s	6.5 ± 1.3
e' Lateral, cm/s	7.8 ± 1.8
Average E/ e'	0.8 ± 0.2

RV assessment	
Dilated RV, n (%)	4 (9.3)
TAPSE, mm	20.8 ± 4.7
RV S', cm/s	12.8 ± 3.1
Peak TR velocity, cm/s	2.1 ± 0.5
Systolic dysfunction, n (%)	7 (16.2)
Dilated LA, n (%)	4 (9.3)
Dilated RA, n (%)	4 (9.3)

Despite the severity of the disease, the majority of the patient had preserved left ventricle ejection fraction (LVEF) and among the total of 43 patients only 5 patients (11.6%) had LVEF < 50%. Thirty-seven patients (86%) had normal diastolic function. Grade 2 diastolic function was observed in five (11.6%) and only one patient had grade 1 diastolic function. The majority of the patients had normal LV dimension and only four patients (9.3%) had dilated LV.

The majority of the patients (90.7%) had normal left atrial dimension only four patients (9.3%) had dilated left atrium.

The right atrial finding were similar to that of left atrial findings. 39 patients (90.7%) had normal right atrial dimension and only four patients (9.3%) had dilated right atrium.

Almost all patients (39, 90.7%) had a normal right ventricle (RV) dimension. Four patients (9.3%) had dilated RV. RV function was preserved in most of the patients (36, 83.7%) and decreased in seven patients (16.28).

Table 2 shows the baseline characteristics and echocardiographic assessments of patients, stratified by COVID-19 severity status.

Table 2: Echocardiographic characteristics of the study population according to severity

Variables	Severe COVID-19 group (n = 28)	Critical COVID-19 group (n = 15)	P-value
Age (years), mean ± SD	56.2 ± 11.4	50.2 ± 14.3	0.14
Gender, n (%)			
Male	19 (67.9)	8 (53.3)	0.60
Female	9 (32.1)	7 (46.7)	
LV assessment			
LVESD (mm)	31.6 ± 7.5	31.9 ± 9.3	0.91
LVEDD (mm)	46.5 ± 5.1	46.7 ± 5.8	0.87
Dilated LV, n (%)	2 (7.1)	2 (13.3)	0.60
Systolic dysfunction, n (%)	3 (10.7)	2 (13.3)	1.0
Diastolic dysfunction, n (%)	4 (14.3)	2 (13.3)	0.88
EF (%)	61.1 ± 9.4	63.4 ± 11.7	0.48
E wave, m/s	5.8 ± 1.6	5.7 ± 1.1	0.80
A wave, m/s	7.3 ± 1.7	7.1 ± 1.8	0.70
E/A	0.82 ± 0.24	0.87 ± 0.36	0.55
e' Septal, cm/s	6.5 ± 1.5	6.6 ± 1.0	0.88
e' Lateral, cm/s	7.8 ± 2.0	7.7 ± 1.4	0.84
Average E/ e'	0.85 ± 0.19	0.87 ± 0.36	0.75
RV assessment			
Dilated RV, n (%)	3 (10.7)	1 (6.7)	0.56
TAPSE, mm	20.5 ± 5.4	21.3 ± 3.3	0.62
RV S', cm/s	12.4 ± 3.2	13.7 ± 2.6	0.17
Peak TR velocity, cm/s	2.1 ± 0.6	2.1 ± 0.5	0.96
Systolic dysfunction, n (%)	5 (17.9)	2 (13.3)	1.0
Dilated LA, n (%)	2 (7.1)	2 (13.3)	0.60
Dilated RA, n (%)	3 (10.7)	1 (6.7)	0.53

The two COVID-19 severity groups were similar in terms of age and gender distribution. In LV assessment, none of the echocardiographic parameters were significantly different between the two groups.The proportion of the patients with dilated LV and systolic dysfunction were higher in the critical COVID-19 group (P >0.05). Presence of diastolic dysfunction was almost similar in the two groups.

Similarly, in RV assessment, systolic dysfunction was found to be higher in severe COVID-19 group compared to the critical COVID-19 group (17.9% vs. 13.3%, P>0.05). Presence of dilated RV was also higher in the severe COVID-19 patients. There was no significant difference in the proportion of patients with dilated RA or dilated LA between the two COVID-19 severity groups.

DISCUSSION

To the best of our knowledge, this is the first of such study in patients with covid-19 infection in Nepal. To minimized spread of the infection, all echocardiographic studies were bedside studies performed at the designated COVID-19 intensive care units with the same small

dedicated scanners which was set aside for covid-ICU.

Despite the elderly age group considered a most vulnerable for COVID-19, this study showed that the mean age of the affected was 54 years. A reasonable explanation to this observation could be the fact that, at this time the majority of the population of age over 65 have had at least one dose of the COVID-19 vaccine. However, this study did not take into account the vaccination status of the patients.

Although several case reports have raised concern about acute cardiac injury related to the infection or cytokine storm resulting in LV systolic dysfunction in patients with COVID-19 infection,[9,10]we found that the LVEF was lower in a handful our patients, with about 11% of patients showing a reduction of LVEF <50%. These findings were similar to the findings in previous studies, where only about 10% of the patients had LVEF <50%.[3,11] In contrast to the results from other studies where LV dysfunction was found in 23%[12] and as high as 41%,[13] our results suggest that although LV systolic dysfunction occurs in patients with acute COVID-19 infection, it is not very common.

Many conditions can increase pulmonary vascular resistance or pulmonary pressure in hospitalized patients and precipitate acute RV failure. These conditions include pulmonary embolism (PE) but also hypoxic pulmonary vasoconstriction, decrease in lung volume, excessive positive end-expiratory pressure, pneumonia, hypercarbia, the use of α-agonists, elevated left atrial pressure, or a combination of all these factors. Early reports suggested that elevated pulmonary vascular resistance in COVID-19 infection is multifactorial and related to parenchymal lung disease, pulmonary vascular disease, and elevated left atrial pressure, all leading to cardiac injury. In contrast to earlier studies,[3,14] RV function was preserved in most of patients we studied, with < 20% of the patients observed to have RV dysfunction.

LIMITATIONS

Our study included only patients with severe and critical COVID-19 infection who were admitted at ICU at Chitwan Medical College from May 16, 2021 to June 05, 2021. A large number of patients requiring mechanical ventilator also needed prone position which rendered preforming echocardiogram impossible. This substantially reduced our study subjects. Although, this was the peak of second wave in Nepal this number was a small fraction of the total infection and include only one center.

Mild and moderate infection were excluded from the study. These patients did not need hospitalizations but was bulk of the overall infected population.

Baseline or prior echocardiogram reports were unknown and there was no follow up echocardiogram study in case of clinical deterioration. Co-morbidities and vaccination status were also not taken into account. This left us with the doubt that whether the observations made could directly be attributed to the infection.

CONCLUSION

In this study we describe the echocardiography finding in patients with severe and critical COVID-19 infection admitted at ICU at Chitwan Medical College. Over 80% percent of the patients had normal findings. Despite the severity of the infection, systolic LV dysfunction was actually uncommon, observed in slightly more than 10%. In contrast to previous studies, RV dysfunction was uncommon and was reported only in <20% of patients.

Our study re-enforces the fact that covid-19 in primarily a respiratory disease and the cardiac complications is largely attributed to the critical illness than the specific infection. Considering the risk of infection spread, we believe that routine echocardiography for all patients with COVID-19 infection is not advisable. On the other hand, an echocardiogram can be crucial in the management of deteriorating patients, allowing better identification of pathogenesis and prompt treatment.

REFERENCES

1. Bhatraju PK, Ghassemieh BJ, Nichols M, Kim R, Jerome KR, Nalla AK, Greninger AL, Pipavath S, Wurfel MM, Evans L, Kritek PA. Covid-19 in critically ill patients in the Seattle region—case series. New England Journal of Medicine. 2020 May 21;382(21):2012-22. [DOI]

2. 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 28;395(10229):1054-62. [DOI]

3. Szekely Y, Lichter Y, Taieb P, Banai A, Hochstadt A, Merdler I, Gal Oz A, Rothschild E, Baruch G, Peri Y, Arbel Y. Spectrum of cardiac manifestations in COVID-19: a systematic echocardiographic study. Circulation. 2020 Jul 28;142(4):342-53. [DOI]

4. Li SS, Cheng CW, Fu CL, Chan YH, Lee MP, Chan JW, Yiu SF. Left ventricular performance in patients with severe acute respiratory syndrome: a 30-day echocardiographic follow-up study. Circulation. 2003 Oct 14;108(15):1798-803. [DOI]

5. Landesberg G, Gilon D, Meroz Y, Georgieva M, Levin PD, Goodman S, Avidan A, Beeri R, Weissman C, Jaffe AS, Sprung CL. Diastolic dysfunction and mortality in severe sepsis and septic shock. European heart journal. 2012 Apr 1;33(7):895-903. [DOI]

6. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, Flachskampf FA, Foster E, Goldstein SA, Kuznetsova T, Lancellotti P. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. European Heart Journal-Cardiovascular Imaging. 2015 Mar 1;16(3):233-71. [DOI]

7. Nagueh SF, Smiseth OA, Appleton CP, Byrd BF, Dokainish H, Edvardsen T, Flachskampf FA, Gillebert TC, Klein AL, Lancellotti P, Marino P. Recommendations for the evaluation of left ventricular diastolic function by echocardiography: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. European Journal of Echocardiography. 2016 Jul 15;17(12):1321-60. [DOI]

8. World Health Organization. (2021). COVID-19 clinical management: living guidance, 25 January 2021. World Health Organization. [Full Text]

9. Hu H, Ma F, Wei X, Fang Y. Coronavirus fulminant myocarditis saved with glucocorticoid and human immunoglobulin. Eur Heart J. 2021;42(2):206. [DOI]

10. Pichon M, Joly V, Argy N, Houze S, Bretagne S, Alanio A, Wassef M, Verillaud B, Yazdanpanah Y. Aspergillus flavus malignant external otitis in a diabetic patient: case report and literature review. Infection. 2020 Apr;48(2):193-203. [DOI]

11. Mahmoud-Elsayed HM, Moody WE, Bradlow WM, Khan-Kheil AM, Senior J, Hudsmith LE, Steeds RP. Echocardiographic findings in patients with COVID-19 pneumonia. Canadian Journal of Cardiology. 2020 Aug 1;36(8):1203-7. [DOI]

12. Sud K, Vogel B, Bohra C, Garg V, Talebi S, Lerakis S, Narula J, Argulian E. Echocardiographic findings in patients with COVID-19 with significant myocardial injury. Journal of the American Society of Echocardiography. 2020 Aug 1;33(8):1054-5. [DOI]

13. Sayed MA, Guru NK, Syed H, Nazneen S, Jaffery S, Soomro A, Khan A, Begum S, Sayed SA. Indications for and Findings on Transthoracic Echocardiography in COVID-19 patients admitted to a Tertiary Care Government Medical Hospital. International Journal of Infectious Diseases. 2022 Mar 1;116:S58. [DOI]

14. Li Y, Fang L, Zhu S, Xie Y, Wang B, He L, Zhang D, Zhang Y, Yuan H, Wu C, Li H. Echocardiographic characteristics and outcome in patients with COVID-19 infection and underlying cardiovascular disease. Frontiers in cardiovascular medicine. 2021 Mar 16;8:642973. [DOI]