



Research Article

Importance of the Echocardiogram in COVID-19 Patients of High-Risk Admitted in ICU

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Abstract

Objectives: To describe cardiac function with echocardiography in COVID-19 patients of high-risk and to determine the influence of hypertension and diabetes in the presence of left ventricular dysfunction. To compare our population and results with others international reports. **Methods and Results:** In a prospective study, we captured the echocardiography findings in 75 consecutive confirmed COVID-19 patients of high-risk, admitted to the ICU between April and September 2021, at Doctors Hospital Health System, Bahamas. Clinical characteristics, kidney function, and ventilator support were analyzed like high-risk variables. Comparisons between groups of patients with abnormal (Group 1) and normal (Group 2) echocardiogram were made using Chi-Square test ($P < 0.05$). A total of 75 patients with an average age of 55 years (25 to 90) were included, 39 p. (52%) male and 36 p. (48%) female. History of arterial hypertension in 60 p. (80%), diabetes 28 p. (37%), abnormal kidney function 33 p. (44%), ventilatory support in 39 p. (52%). Overall, we did an echocardiogram and 45/75 p. (60%) had an abnormal echocardiogram. Left Ventricular systolic dysfunction in 33/45 p. (73%), moderate to severe was reported in 18/33 p. (54%). Right Ventricular systolic dysfunction in 12/45 p. (27%), moderate to severe in 7/12 p. (58%). Bi ventricular severe systolic dysfunction in 8/45 p. (18%). Patients with evidence of new myocardial infarction (STEMI) in 3/45 p. (4%), 2 patients received coronary stent and no mortality and 1 p. normal coronary angiogram. We compare clinical characteristic of patients with abnormal echocardiogram (Group 1) and normal echocardiogram (Group 2). Group 1, abnormal echocardiogram, had a higher percentage of hypertensive patients (29 p., 65% vs. 11 p., 36%), diabetic patients (28 p., 62% vs. 10 p., 33%) and patients with both risk factors (28 p., 62% vs. 10 p., 33%), alterations in renal function (33 p., 73% vs. 10 p., 33%) and ventilatory support (29 p., 64% vs. 10 p., 33%) than normal echocardiogram group. Differences were statistically significant (CI 95 %: 0,1 % to 1,4 %; $P < 0.05$). **Conclusion:** In this research in the Bahamas, left and right ventricular dysfunction were observed in more than half of all high-risk COVID-19 patients admitted at ICU undergoing echocardiography. This ventricular dysfunction has strong relation with arterial hypertension, diabetes, abnormal kidney function and ventilatory support.

Keywords: COVID-19; Echocardiography; Ventricular Dysfunction

Introduction

Coronavirus disease 2019 (COVID-19) has become one of the leading causes of morbidity and mortality worldwide [1-3]. The severe acute respiratory syndrome of the coronavirus (SARS-CoV-2) it's most frequent and important complication [4]. However, it has been observed that patients can also develop impaired heart function [5-7], both left and right, secondary to vascular micro thrombosis with endothelial damage and tissue inflammation with high levels of local pro-inflammatory cytokines [8-10]. Virus particles have been found in the myocardium and vascular endothelium in patients with COVID-19 and cardiogenic shock justifying this mechanism of action [11-13]. But it also arises as a consequence of elevations in the after load of the right ventricle due to pulmonary embolism, pulmonary vasculopathy due to micro thrombosis or pneumonia [14,15]. Patients with cardiovascular diseases and cardiac risk factors are more susceptible to these cardiac complications and have a worse prognosis [5-7]. Cases of COVID-19 related to myocarditis [8], acute myocardial infarction [16], and takotsubo cardiomyopathy [17] have been reported. The incidence of these cardiac complications and their relationship with cardiac risk factors in different parts of the world are known, but there are no reports on Caribbean countries. This information is critical since our population has a high incidence of high blood pressure and diabetes. Echocardiography was proposed as a control method in these high-risk patients, since we believe it is a method that can help better understand the patient's situation and predict the appearance of complications. Our objective was to know the cardiac function of patients with high-risk COVID-19 in our population and to provide information on the influence of arterial hypertension and diabetes in the presence of systolic ventricular dysfunction and an evolution with a worse prognosis.

Methods

This prospective research work was designed by the Cardiology Service of Doctors Hospital, Nassau Bahamas, with the contribution of experts in infectious diseases and nephrologists responsible for the ICU Unit for Covid19 patients in the Bahamas. 75 consecutive patients with a diagnosis of Covid19 admitted to the ICU due to high-risk respiratory and/or cardiac criteria were included. Patient images were taken as part of routine care and unidentifiable patient data was captured. As such, this research work did not require the individual consent of the patient. Samples and results were compared with other similar works published with the endorsement of the European Society of Cardiology. In the primary analysis, patients with COVID-19 with high-risk criteria were included, admitted to the intensive care unit (ICU) defined as high dependency on invasive medical service, blood pressure control, heart rate, and O₂ saturation in arterial blood, intravenous

medication, inotropics and/or intubated and ventilated patients or with ventilatory support of any kind. Basic characteristics were recorded: age, sex, co morbidities, and need for ventilatory support. Patients were considered in respiratory failure when they presented PaO₂/FiO₂ <250, respiratory rate greater than 30 x min, confusion or altered state of consciousness, systolic pressure <90 mmHg, multilobar radiographic compromise, high risk score on CT. Cardiac involvement was suspected when the patient presented signs or symptoms of left and/or right heart failure, systolic arterial hypotension less than 90 mmHg, chest pain with new changes in the ST segment on the electrocardiogram (supra slope greater than 1 mm or greater than 2 mm), elevation of cardiac biomarkers [troponin or CPK MB), ventricular or supraventricular arrhythmia, suspected tamponade or cardiogenic shock. Echocardiographic findings were captured for Left Ventricular abnormalities (mild, moderate, or severe systolic dysfunction, LV dilation, evidence of new myocardial infarction, myocarditis, or takotsubo cardiomyopathy), Right Ventricular abnormalities (mild, moderate, or severe systolic dysfunction), RV dilation, presence of intraventricular or atrial thrombi) and interventricular septum motility disorders, pulmonary artery dilation, mild, moderate, severe pericardial effusion, with or without cardiac tamponade.

Statistical analysis

Age was reported as means and ranges, and categorical variables were reported as frequencies (%). Comparisons between groups were made using the independent samples Chi-Square test (P<0.05). Group 1, or patients with abnormal echocardiography, was selected according to the echocardiographic presence of an abnormal Left Ventricle (any degree of Left Ventricular dysfunction or dilatation, myocardial infarction, myocarditis, or Takotsubo cardiomyopathy) or abnormal Right Ventricle (any degree of RV dysfunction or dilatation of the right ventricle and/or the pulmonary artery and interventricular septum motility disorders). Covariates included age, sex, arterial hypertension, diabetes mellitus, respiratory support, and renal function measured with BUN and plasma creatinine. The analysis was performed using the McNemar test calculator / Chi-Square test of independence (P<0.05).

Results

In a prospective study, we captured the echocardiography findings in 75 consecutive high-risk COVID-19 patients admitted to the ICU between April and September 2021, at Doctors Hospital Health System, Bahamas. Clinical characteristics, kidney function, and ventilator support were analyzed like high risk variables. The general population presented an average age of 55 years and an equal percentage of men (39 p., 52%) and women (36 p., 48%). In the general population of 75 p., a high prevalence of arterial hypertension (60 p., 80%) and diabetes (28 p., 37%) was observed, as well as in patients who had a history of both risk factors (28

p., 37%) (Figure 1). It was also observed that 33 p. (44%) had abnormal renal function and a high percentage of patients were also on ventilatory support (39 p., 52%). This high prevalence of cardiac and renal failure, risk factors, and ventilatory assistance characterizes a group of patients with high risk of complications. All patients underwent an echocardiogram to assess systolic cardiac function and left and right heart size and wall structure and movement. This paper analyzes left and right ventricular systolic function and its relationship with the hypertension and diabetes and other high-risk variables such as kidney function and ventilatory support. According to the results of the echocardiography, the patients were separated into two groups. Patients with abnormal echocardiogram (Group 1) and normal echocardiogram (Group 2). Both groups presented similar amounts of men and women and average age. Patients with abnormal echocardiogram, Group 1 (45/75 p. 60%). Left Ventricular systolic dysfunction 33/45 p. (73%). Mild in 15/33 p. (45%), moderate in 10/33 p. (30%) and severe in 8/33 p. (24%) were reported. Right Ventricular systolic dysfunction 12/45 p. (27%), moderate to severe in 7/12p. (58%) were reported. Systolic Dysfunction of both ventricles was observed in 8/45 p. (18%) (Figure 3). All patients presented some degree of dilation of the left and/or right ventricle, and global motility disorders in 33 p. (73%) and regional in 12 p. (26%). Hypokinesia/akinesia of the anterior wall of the left ventricle was observed in 5 p. (41%). No intracavitary thrombi were observed in the ventricles or atria. Three patients with a diagnosis of high-risk Stemi due to acute infarction of the anterior wall of the left ventricle with ST-segment elevation entered the group of patients with abnormal echography. The three patients were admitted to the Cath Lab for Coronary Angiogram, two patients had severe arterial occlusions that required coronary angioplasty and stent placement. The other patient presented a coronary angiogram without significant coronary stenosis. Pericardial effusion was observed in 27 p. (60%), mild to moderate. Severe or cardiac tamponade was observed in 3 patients. No patients with Takotsubo cardiomyopathy or endocarditis were observed. Group 2 corresponded to patients with normal echocardiography. It was observed that the Group 1 of patients with abnormal ultrasound had a higher percentage of hypertensive patients (29 p., 65% vs. 11 p., 36%), also about diabetic patients (28 p., 62% vs. 10 p., 33%) and patients with both risk factors (28 p., 62% vs. 10 p. 33%), difference statistically significant (CI 95 %: 0,1 % to 1,4 %; P<0.05). (Figure 2). The Group 1 or patients with abnormal echocardiography due to left and/or right ventricular dysfunction also had a greater number of patients with alterations in renal function (33 p., 73% vs. 10 p., 33%) and ventilatory support (29 p., 64% vs. 10 p., 33%), differences were statistically significant (CI 95 %: 0,1 % to 1,4 %; P<0.05) (Figure 2).

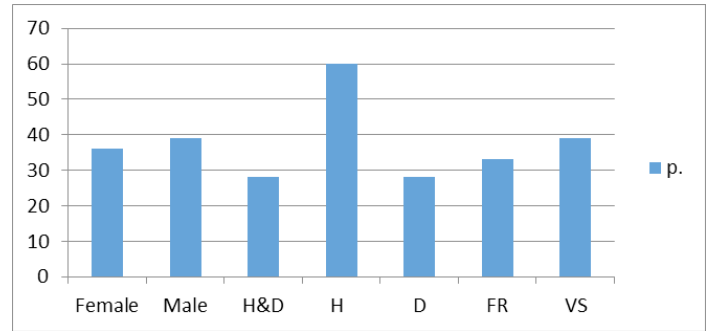


Figure 1: General Population, clinical characteristics and risk factors in number of patients (Female, Male, H: Hypertension, D: Diabetes, H&D: Hypertension and Diabetes, FR: Abnormal Kidney Function, VS: Ventilatory Support).

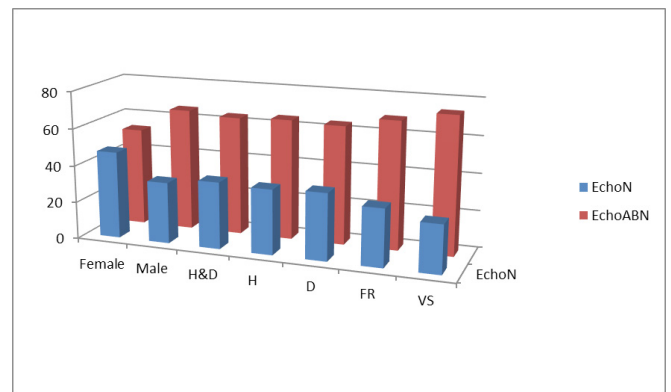


Figure 2: Clinical characteristic and risk factors, comparative Group 1 or Abnormal echocardiogram (EchoABN) and Group 2 or Normal echocardiogram (EchoN) in % of patients (female, Male, H: Hypertension, D: Diabetes, H&D: Hypertension and Diabetes, FR: Abnormal Kidney Function, VS: Ventilatory Support).

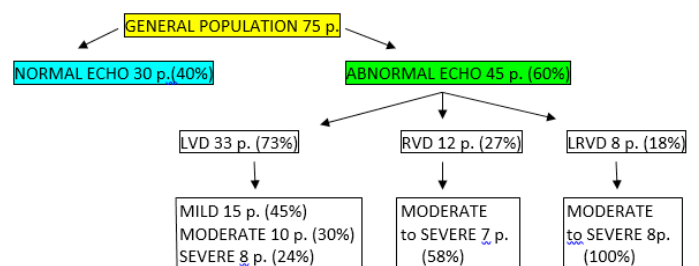


Figure 3: Echocardiogram report in patients with COVID 19 of High Risk in ICU. LVD: Left Ventricular Dysfunction, RVD: Right Ventricular Dysfunction, LRVD: Left and Right Ventricular Dysfunction.

Discussion

Data from 75 patients undergoing echocardiography were collected, which means a sample similar to that reported in different major centers in Europe [18]. It is interesting to analyze our patient population and results by comparing them with an important report issued by the European Society of Cardiology (SEC) [18]. It can be seen that in our population all patients had a confirmed diagnosis of covid-19, while 73% of the European sample had it [18]. Our population had a lower average age than reported by our colleagues (55 vs. 62 years). In addition, our percentage of men and women was similar, while they had a sample with almost 70% men and only 62% were in the ICU or critical care units for severe symptoms [18]. When we analyze the risk factors, arterial hypertension and diabetes, we can see important differences. While they report a prevalence of hypertension of 37% and diabetes mellitus of 19% in their population, we have a much higher percentage of patients with hypertension (80%) and diabetes (37%), as well as in patients who had a history of both risk factors (37%) in the general group. This implies a sicker population and a higher risk of major complications. Similarly, the high incidence of patients with kidney failure and in need of ventilatory support is high in our group of patients with high-risk COVID19, which shows a direct relationship, either as a previous manifestation related to hypertension and diabetes, or secondary to COVID19.

Echocardiographic Findings

The European study [18] reports a normal echocardiogram in 45% of its patients, which is similar to our report. However, the results differ when we analyze arterial hypertension and diabetes, which in their normal and abnormal echocardiography group had a similar prevalence [18]. In our population, group 1 or abnormal echocardiography due to left, right or biventricular systolic dysfunction, has a much higher percentage of patients with arterial hypertension, diabetes and both factors, with a clear statistical significance, which almost doubles the prevalence of these factors in group 2 or normal echocardiography. Not only can we say that our population is sicker but also that this directly influences the presence of systolic dysfunction of the left and right ventricle or both. When we analyze renal failure criteria by laboratory and patients with respiratory assistance, we can also observe a greater number of patients in the group with abnormal echocardiography compared to group 2 or normal echocardiography, with a statistically significant difference. These two variables, which were not analyzed in the European study [18], are observed in more than twice as many patients in group 1 and are very important in evaluating the patient's risk, since they are also imposed as independent risk variables with statistical significance.

Left ventricular systolic dysfunction was reported in 73% of our patients (33p.), half of them moderate to severe, which also shows a difference with the European sample that reports 39% of patients with this condition [18]. Our patients had a very low incidence of ST-segment elevation myocardial infarction (STEMI) as did the European population. Our study reports right ventricular systolic dysfunction in 27% of patients, with moderate to severe impairment in 58% of these patients. The pattern of the left ventricle without echocardiographic evidence of dysfunction but with deterioration of the right ventricle, observed in our experience, seems to be related to the pulmonary affection of covid-19, the inflammation of the parenchyma and the micro or macro vascular thrombosis with the consequent increase in resistance to right ventricular blood flow. These isolated cases of right ventricular systolic dysfunction likely reflect more extensive and severe respiratory disease. Left ventricular hypokinesias were present in two-thirds of the patients and were predominantly nonspecific and global in nature. Further investigation is required to define the mechanism of this dysfunction since in few patients the echocardiographic patterns were compatible with myocardial infarction, with regional wall motion disorders. Surely global hypomotility is related to myocarditis and myocardial inflammation. Our study suffers from the usual limitations associated with the low number of patients included. With this design we seek to carry out a study that captures basic echocardiographic findings, easy to obtain for any echocardiographer, and their relationship with risk factors of high prevalence in our population. We consider that our populations are different from the great works published in Europe, and that it is a challenge to extrapolate data. Each region should plan research that provides data from the real world and allows progress with protocolized examinations and effective treatments. Surely new designs and the inclusion of more patients will allow us to better understand the usefulness of echocardiography in high-risk population groups.

Conclusion

In this investigation in the Bahamas, left and right ventricular systolic dysfunction was observed by echocardiography in more than half of all high-risk COVID-19 patients admitted to the ICU undergoing echocardiography. Our high-risk patients had a high prevalence of hypertension and diabetes. Also, systolic ventricular dysfunction was strongly related to arterial hypertension, diabetes, abnormal renal function, and ventilatory support.

Conflicts of Interest

This manuscript has not been published and is not under consideration for publication elsewhere. We have no conflicts of interest to disclose.

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