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New-Onset myocardial injury in COVID-19 Pregnant Patients: A Case Series of 15 Patients

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All authors declare no conflict of interest.

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Condensation:

Myocardial injury is frequent in severe COVID-19; pregnant women with COVID-19 could be more susceptible to myocardial injury and adverse outcomes.

Short Title: Myocardial Dysfunction in COVID-19 pregnant women.

AJOG at a Glance:

A. Why was the study conducted?

- To assess the characteristics and outcomes of COVID-19 and myocardial dysfunction in 15 pregnant patients.

B. What were the main findings?

- Fifteen patients with diagnosed COVID-19 developed myocardial injury.
- 66.7% presented with shortness of breath and 16.3% with palpitations.
- All patients needed to be transferred to ICU
- 86.6% were intubated
- All patients had myocardial dysfunction with highly elevated troponin and BNP concentrations.
- All patients developed left ventricular dysfunction.
- Two patients passed away due to torsades de pointes and sustained supraventricular tachycardia.

C. What does this study add to what is already known?

- This study illustrates the clinical and baseline characteristics of pregnant women who developed COVID-19 induced myocardial injury.
- Although our patients were previously healthy with no cardiovascular risk factors and diseases, they developed severe COVID-19 induced myocardial injury and ventricular dysfunction.
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Abstract

Background: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the new coronavirus responsible for the coronavirus disease (COVID-19), characterized by acute respiratory distress syndrome and atypical pneumonia. In non-pregnant women, studies have shown that SARS-CoV-2 causes cardiac injury, which can result in myocardial inflammation and damage. Despite many studies investigating the extent of cardiac compromise in severely ill COVID-19 patients, little is known regarding its impact on pregnant women.

Objective: To illustrate the clinical, laboratory, radiological findings, and outcomes of COVID-19 pregnant patients who developed myocardial injury with ventricular dysfunction.

Study Design: We retrospectively reviewed the paper records of fifteen pregnant women with COVID-19, who developed myocardial injury on a single tertiary care hospital in the Dominican Republic. Patient's baseline characteristics, clinical picture, laboratory, and radiological findings were presented, and maternal and fetal outcomes were analyzed.

Results: Of 154 pregnant patients diagnosed with COVID-19 at our hospital during the study period, 15 (9.7%), developed myocardial injury. These patients' mean age and gestational age were 29.87 ± 5.83 and 32.31 ± 3.68, respectively. 66.7% of patients presented with shortness of breath and 16.3% with palpitations. All patients were admitted to the intensive care unit, and 86.6% needed intubation. Patients developed myocardial injury confirmed with highly elevated troponin (34.6 [14.4-55.5 ng/ml]), and pro-BNP concentrations (209 [184-246 pg/ml]). Additionally, all patients developed left ventricular dysfunction demonstrated by an echocardiogram with a mean left ventricular ejection fraction (LVEF) of 37.67 ± 6.4 %. Two patients that presented with palpitations passed away a few days after admission.

Conclusion: Our study showed COVID-19 induced myocardial injury and left ventricular dysfunction in pregnant women with a 13.3% mortality rate which was attributed to malignant arrhythmias.

Keywords: COVID-19; pregnancy; myocardial injury; ventricular dysfunction; SARS-COV-2; cardiovascular disease; coronavirus

Introduction

Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) is the new coronavirus, responsible for the highly infectious coronavirus disease (COVID-19), which was declared a global public health emergency by the World Health Organization (WHO) on March 11, 2020 [1-3]. As of August 9, 2020, more than 19 million confirmed cases of COVID-19 had been reported globally, with 727,317 deaths [4]. Emerging studies demonstrated the deleterious effect of SARS-CoV-2 on the cardiovascular (CV) system such as myocardial injury which is associated with myocardial inflammation and damage [5]. Almost 33% of non-pregnant COVID-19 patients admitted to the intensive care unit (ICU) develop cardiac injury [6]. Despite many studies investigating the COVID-19 effect on adult patients' heart, little is known regarding its impact on pregnant women.

Pregnancy leads to physiological, immunological, and mechanical changes that increase susceptibility to infectious respiratory organisms predisposing to more severe illnesses [7]. Angiotensin-converting enzyme 2 (ACE-2) receptors are believed to be the door for SARS-CoV-2 entry into the host cells. Interestingly, ACE-2 receptors expression is increased during pregnancy. SARS-CoV-2 downregulates ACE-2 receptors eliminating its cardioprotective effect and leading to increasing concentrations of tumor necrotic factors alfa and inflammation, which could be the possible cause of myocardial dysfunction in pregnant and non-pregnant COVID-19 patients [5]. In recent COVID-19 surveillance by the Center for Disease Control (CDC), pregnant women were more likely to require hospitalization than non-pregnant women (31.5% vs. 5.8%, respectively).

Moreover, pregnant women were significantly more likely to be admitted to ICU and receive mechanical ventilation (adjusted relative risk =1.5, 95% confidence interval=1.2-1.8) compared to non-pregnant COVID-19 positive patients[7]. Intriguingly, there is a lack of studies investigating the effect of

COVID-19 on pregnant women's CV system. To our knowledge, only one study by Juusela et al., showed the occurrence of cardiomyopathy in COVID-19 pregnant women, according to their results, out of seven pregnant women with COVID-19 two developed cardiac dysfunction (28.6%; 95% CI, 8.2%–64.1%) with moderately reduced left ventricular ejection fraction of 40%–45% and hypokinesis [8]. Therefore, it is crucial to understand the impact of COVID-19 on the heart of pregnant women. This case series aims to describe the baseline, and clinical characteristics, laboratory, radiological findings, and outcome of fifteen pregnant women admitted to a single tertiary care hospital with COVID-19 and who developed myocardial injury. Investigating these cases would help provide a better understanding of possible risk factors of COVID-19 in the pregnant population and provide data to possibly help in counseling pregnant women with such complications.

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Material and Methods

Study population and design

To determine the clinical characteristics and evolution of myocardial injury in critically ill COVID-19 pregnant patients, we conducted a single-center, retrospective observational study between March 20 and June 30, 2020, in an obstetric tertiary level hospital in Santo Domingo, Dominican Republic. The study population consisted of fifteen pregnant patients admitted to the hospital with confirmed COVID-19 disease by real-time reverse transcriptase-polymerase chain reaction (RT-PCR) assay of nasopharyngeal swab specimens and developed myocardial injury. The study was approved by the Institutional Review Board and the bioethics committee in the Public Health Ministry in the Dominican Republic (CONABIOS) before accessing the data, and informed consent was obtained.

Data collection

Data from the paper records in the hospital archives section was retrieved after patient discharge or death. Data consisted of prenatal demographics and clinical characteristics, patients', laboratory ECG and radiological findings, and outcomes.

Patients' baseline and clinical characteristics consisted of patients' age, Body Mass Index (BMI), presence of chronic diseases, gestational age (GA), Gravida-Para-Aborta-C Section (GPAC), and prenatal course. In Addition to patients' chief complaint (CC), CC duration, ICU admission, and need for intubation.

Laboratory findings consisted of cardiac enzymes: cardiac troponin I (cTnI) and N-terminal pro-B-Type natriuretic peptide (NT-proBNP) with normal concentration being <0.4 ng/ml and <100 pg/ml respectively. As per the Academic College of Cardiology recommendations, patients' were considered

to have myocardial injury if troponin concentration were above the 99th percentile upper reference limit; >0.4 ng/ml [9].

Electrocardiogram (ECG) measurement consisted of rhythm, presence of bundle branch block (BBB), S.T. elevation, and T wave inversion. Radiological findings of chest radiographs consisted of the presence of consolidation, ground-glass, and cardiothoracic index (CTI). Whereas transthoracic echocardiography (TTE) measurements consisted of left ventricular ejection fraction (LVEF), left ventricular dilation (LVD), left atrial dilation (LAD), and left ventricular (LV) hypokinesis. Left ventricular dysfunction was considered in patients with LVEF ≤ 49% [10].

We also recorded information related to the mode of delivery and gestational age. Maternal and infant outcomes, neonate weight (Kg), length (cm) and Activity, Pulse, Grimace, Appearance, and respiration (APGAR) scores at 0 and 5 minutes and if they were admitted to neonatal intensive care unit (NICU). APGAR score was considered reassuring if 7-10, moderately abnormal if 4-6, and low if 0-3[11].

Statistical analysis

Analyses were conducted using SPSS 24 for Windows (SPSS Inc, IBM). Categorical variables are presented as frequencies with percentages, and continuous variables are presented as means ± standard deviations for normally distributed values and median and interquartile ranges (IQR) for non-normally distributed values.

Results

Among 154 symptomatic pregnant patients that attended our hospital with COVID-19 between March 20 to June 30, 2020, 77 (50%) had moderate disease and were admitted to the hospital floor, 34 (22%) had severe disease and needed ICU admission and 15 (9.7%) developed myocardial injury with left ventricular dysfunction.

Baseline and Clinical Characteristics

Patients were 29.87 ± 5.83 years-old and at 32.31 ± 3.68 weeks of gestation. All patients were previously healthy and only 13.3% had prenatal bleeding (Table 1). From fifteen patients, 66.6% presented to the hospital with SOB, 13.3% with palpitations, 13.3% with DFM, and 6.6% with fatigue. Patients were admitted to the hospital approximately 9.93 ± 3.13 days after the start of symptoms. All patients had severe disease and were admitted to the ICU and 86.6% were intubated.

Laboratory, ECG, and radiographic findings

All patients tested positive for SARS-CoV-2 by PCR and had reactive COVID ELISA IgM. All patients had elevated cardiac enzymes were the median and interquartile range for troponin and Pro-BNP were 34.6 [14.4-55.5 ng/ml] and 209 [184-246 pg/ml] respectively (Table 2). Almost 55% of patients had abnormal ECG findings where 13.3% had irregular rhythms, 33.3% BBB, 40% ST depression, and 40% T wave inversion. In terms of patients' chest x-rays, all patients had lung consolidation, and 6 (40%) had ground-glass opacities. The CTI of patients were 0.5 ± 0.06. In terms of patients TTE, all patients had abnormal findings were all presented with left ventricular dysfunction with a mean LVEF of 37.67 ± 6.4 and LV diffuse hypokinesis. Additionally, 20% had left atrial dilatation and 13% LV dilation.

Maternal and infant outcome

All patients were delivered by c-section were 60% were delivered prematurely. The mean gestational age at delivery was 34.2 ± 4 weeks. From fifteen patients 13.3% died after delivery due to malignant arrhythmias (ventricular tachycardia and torsade de point). One clinically unstable mother was delivered at 23.3 weeks of pregnancy by an emergent c-section due to a significant decrease in fetal heart rate; the child was delivered and was unresponsive with an APGAR score of 0 at 0 and 5 mints. No autopsy or additional tests were performed to determine the cause of death (Table 3). A great proportion of patients had to deliver their babies prematurely (60%) due to their unstable clinical (unstable vitals, severe hypoxemia arrhythmia) condition and fetal bradycardia. This was decided when the physician believed that the continuation of pregnancy results in jeopardy of the mother and fetus's life.

From 14 infants, 6 (35.7%) of the infants had low birth weight (weight <2.5 Kg) and 1 (7.1%) had very low birth weight (<1.5 Kg).8 (57%) of the infants had a reassuring APGAR score at 0 and 5 minutes, 3 (21.5%) had a moderately depressed APGAR score at 0 min and a reassuring score at 5 min and 3 (21.5%) had a moderately depressed score at 0 and 5 mins. Additionally, 5 (35.7%) infants were admitted to the NICU (premature infants with low birth weight) and discharged later.

Discussion

Principal Findings of the study

Our study showed the different baseline and clinical characteristics, laboratory, and radiological findings, and outcomes of fifteen pregnant women with confirmed COVID-19 who developed myocardial injury with left ventricular systolic dysfunction. The patients were young, previously healthy women in the third trimester of pregnancy. The most common hospital presentation was shortness of breath, followed by palpitations. All of them had a positive RT-PCR test and chest x-ray confirming COVID-19. Cardiac injury biomarkers were elevated in the fifteen cases, with some showing ECG changes and all having decreased LVEF. All patients were critical and were admitted to the ICU, and thirteen (86.6%) were intubated. Unfortunately, two (13.2%) patients passed away a few days after admission due to arrhythmia.

Results of the study in the context of what is known

There is a surge in studies demonstrating the deleterious effect of COVID-19 on the CV system [12]. In non-pregnant women, COVID-19 has been associated with cardiovascular diseases (CVD) such as myocarditis, acute myocardial infarction, cardiomyopathy, arrhythmias, and venous thromboembolic events [12]. Myocardial injury is the most common reported CV event in COVID-19 patients and is independently associated with high mortality [12,13]. Myocardial injury with elevated cardiac markers occurred in 7-17% of patients hospitalized with COVID-19 and 22-31% in more severe cases admitted to the ICU [12]. In a cohort study of 191 symptomatic hospitalized COVID-19 patients, 33 (17%) developed myocardial injury in which 32 (97%) died [13]. This high mortality rate can be attributed to the fact that 63% of 191 COVID-19 patients had severe or critical disease status. In another study, 20% of COVID-19 patients developed myocardial injury, and they were five times more likely to need

mechanical ventilation and eleven times more likely to die in comparison with non- cardiac affected patients[13]. There are several mechanisms of myocardial injury with myocarditis or systemic inflammation being the most common. It is worth noting that all of these findings were in non-pregnant COVID-19 women with limited studies investigating the CV effect of COVID-19 in pregnant women. To our knowledge, there is only one study that shows the cardiac effect of COVID-19 in pregnancy [8]. In this case series, two pregnant women with COVID-19 developed cardiac dysfunction with moderately reduced LVEF (40-45%) and hypokinesis. These two patients were previously healthy with some CV risk factors such as race/ethnicity, obesity, and one had advanced maternal age. Both patients delivered their babies by c-section and were isolated in negative-pressure rooms. The outcome was still unknown since, at the time of article writing, they were still admitted to ICU recovering. Similarly, in our study, out of 154 pregnant women with COVID-19 referred to the hospital, 15 (9.7%) developed myocardial injury with reduced LVEF, which ranged from 22-45% with a 37.67 ± 6.4 mean. All fifteen cases had very high elevated troponin and BNP concentrations with or without ECG changes and were admitted to the ICU. It is unknown if the incidence of cardiac injury in these patients is due to the direct effect of SARS-CoV-2 virus or secondary to multiorgan failure due to overwhelming critical illness. Older patients with COVID-19 and comorbidities are more likely to developed cardiac injury. Intriguingly, our patients were young, previously healthy females with minimal CV risk factors; this makes a statement regarding the impact of COVID-19 disease in the CV system. It can cause cardiac compromise, even in the absence of previous CVD. It is worth mentioning that surprisingly, two studies showed that the prevalence of acute myocardial injury in COVID-19 patients increased patients' mortality significantly more than age, previous CVD, CV risk factors, and chronic pulmonary disease [6,14]. Therefore, it is essential to identify cardiac injury in pregnant patients to avoid complications early in their disease course.

Arrhythmia and sudden cardiac arrest are also common CV complications of COVID-19 patients [15],[13]. A Chinese study of 138 hospitalized patients with COVID-19 showed that 23 patients (16.7%) developed arrhythmias, and 16 (69.5%) required ICU admission [15]. Over 7% of COVID-19 patients present with palpitations[13]. Studies have shown a range of arrhythmias in COVID-19 patients with sinus tachycardia being the most common type [13]. This fact is consistent with our findings because 26.6% of patients had sinus tachycardia, and 13.3% had atrial fibrillation. Unfortunately, the two patients that presented with atrial fibrillation had an emergency c-section and passed away 3 and 6 days after hospitalization due to torsade de pointes and sustained ventricular tachycardia. In our study, the new-onset atrial fibrillation in patients with respiratory distress syndrome is associated with an increase in the 90-day mortality [16]. In contrast, In the study by Juusela et al., one patient developed supraventricular tachycardia and received high dose metoprolol, but fortunately recovered [8]. We believe that the prevalence of arrhythmia in these patients could be secondary to electrolyte imbalance, COVID-19 by itself, myocardial injury, and hypoxia.

Literature shows the controversial prevalence of COVID-19 induced left ventricular systolic dysfunction. One systematic prospective echocardiography study of 100 COVID-19 patients (>18 years), who had an echocardiograph within 24 hours of admission showed that the prevalence of systolic LV dysfunction was uncommon (<10%)17. This percentage consisted of patients with mild, moderate, and severe COVID-19 disease with or without troponin elevations. Additionally, from 100 patients, only 20% had elevated troponin concentrations in which 15% had associated reduced LVEF. On contrary, a study, 125 patients with COVID-19 admitted to a hospital were assessed for the prevalence of LV dysfunction 18. This population consisted majorly of severe COVID-19 69% of the patients who

309 were admitted to the ICU with 88% requiring mechanical ventilation. From 125 patients, 22% had an
310 impaired LVEF (<50%). Whereas, from 125 patients only 93 had cardiac biomarkers measure. Almost
311 50% of patients with elevated cardiac enzymes (troponin concentration ≥ 50 ng/L) had LV dysfunction.
312 Similarly, in a retrospective study of 72 COVID-19 patients who had echocardiography due to major
313 concern of acute cardiovascular event or due to hemodynamic instability, 34.7% had a reduced LVEF in
314 which 45.7% had an elevated troponin concentration and reduced LVEF 19. It is worth noting from
315 these patients, it was unknown who had pre-existing LV dysfunction. Both studies showed that the
316 prevalence of ventricular dysfunction in COVID-19 patients to be common which is consistent with our
317 study 18,19. However, when compared with our study, from fifteen patients with elevated cardiac
318 troponin concentrations 100% had reduced LVEF. This raises the question of an increased prevalence of
319 COVID-19 induced systolic dysfunction in pregnant women when compared to non-pregnant patients.
320
321 Troponin elevation in COVID-19 is directly proportionate to adverse outcomes and mortality 12. The
322 presence of positive troponin concentrations is associated with severe illness and poor outcomes in
323 COVID-19 patients. These patients are five times more likely to need ventilation, develop arrhythmias,
324 and die. In contrast, patients with mild disease rarely have elevated troponin concentrations (1-2%) [20].
325 The National Health Commission of China reported that 12% of COVID-19 patients present with an
326 elevated troponin level. Additionally, they stated that 46% of COVID-19 non-survivors had elevated
327 troponin concentrations versus 1% of survivors. These findings support the association of elevated
328 troponin concentrations with increased mortality[21]. The magnitude and rate of troponin elevation are
329 directly associated with poor outcome [22]. Troponin concentrations in COVID-19 patients were
330 repeatedly measured at 4,10, 13, and 22 days of infection and were 2.5, 4.1, 4.,4, and 3.8 ng/ml
331 respectively in survivors and 8.8, 22, 55, and 290.6 ng/ml in non-survivors [23]. In a meta-analysis of 4

studies, patients with severe COVID-19 had significantly higher troponin concentrations than mild COVID-19 cases [24]. Whereas, in our study, all patients had elevated troponin concentrations, which had an interquartile range of 14.4-55.5 ng/ml]. Additionally, all had a moderate to a severe course of disease needing ICU admission. Unfortunately, we had two fatalities due to arrhythmias in our study, which were associated with the highest troponin concentrations (641 and 750 ng/ml, respectively). A study in Wuhan supports this, demonstrating an increased risk of malignant arrhythmias such as ventricular tachycardia and fibrillation in patients with elevated troponin concentrations compared with patients with normal concentrations [13]. This potentially can be one of the major factors leading to increased mortality in these patients. While troponin demonstrated to be an excellent prognostic marker, BNP has shown a similar role [25]. Increased BNP concentrations in COVID-19 patients is a marker of cardiac injury and is associated with in-hospital death [26]. A study by Guo et al., showed that elevated troponin and BNP are significantly associated with each other [14]. Moreover, Shi et al. demonstrated elevated BNP concentrations in COVID-19 patients with cardiac involvement compared to patients with no cardiac involvement. Additionally, these patients had a significantly higher mortality rate, which reached 51.2% of cases [6]. Therefore, routinely measuring these biomarkers at admission would play an essential role in decreasing mortality in high-risk patients.

Multiple studies illustrated the clinical picture of COVID-19 in pregnant women [4,27]. In a cohort study of 64 severely or critically ill pregnant women with COVID-19 admitted to the hospital in the USA, no incidence of CV complication was noted except for one episode of cardiac arrest [4]. Additionally, no maternal mortality occurred. Whereas, in our study of 154 pregnant women diagnosed with COVID-19 9.7% developed myocardial injury and 13.3% died. In terms of delivery, 60% of our patients delivered prematurely which is consistent with this cohort study where 59.4% of patients who delivered during

hospitalization had a preterm delivery of <37 weeks and 31.2% of <34 weeks. Furthermore, the mean birthweights of neonates were somewhat similar (2.2±0.7 Kg in our study vs 2.4±0.8 Kg in the cohort study) which is likely due to the early gestational age of mothers. However, contrary to our study no fetal demise has occurred. In the cohort study, 63.3% (vs 35% in our study) of neonates were admitted to the NICU. In this cohort study, patients were characterized according to the severity of COVID-19; severe vs critical. The average rate of NICU admission of neonates was 63.6% for all patients and 40% for severely ill and 83.3% for critically ill patients. Whereas, in our study, 35% of neonates were admitted to the NICU. Another cohort illustrated the clinical characteristics and outcomes of COVID-19 in 158 COVID-19 pregnant women [27]. The study classified patients into asymptomatic or mild disease (78%) and moderate or severe disease (22%). Interestingly, in this study, no CV complications were reported. From 15 hospitalized patients with moderate to severe disease, only one (6.6%) was intubated (vs 86.6% were intubated in our study) and 9 (60%) were admitted to the ICU (vs 100% in our study). Additionally, only 2 (13.3%) of women had a preterm delivery (vs 60% in our study). All of this data shows the great variance in the prevalence and severity of COVID-19 among the different population."

Clinical and Research Implications

This case series has important implications for obstetric practice and research. It demonstrates that there is a major lack of knowledge and literature, showing the need for further studies to investigate the potential effect of COVID-19 on the heart of pregnant women. A case-control study investigating if there is a difference in the effect of COVID-19 on the CV system between pregnant and non-pregnant women with COVID-19 is essential. In addition, a larger-scale study of COVID-19 outcomes in pregnant women taking into consideration different gestational trimesters, the presence of CV risk factors and comorbidities would be necessary to draw conclusions. This would be very important

especially in the third trimester of pregnancy were maternal risk of decompensation and complications increases.

Strengths and Limitations

This study has limitations, like many others. First, our study comprises a small sample size; a more extensive cohort study is needed to confirm our findings. Second, only symptomatic pregnant women were tested for COVID-19, which could result in overestimation in COVID-19 and cardiomyopathy association in pregnancy. Third, we could not provide a clear understanding of the rate of cardiac injury in our population was due to COVID-19, pregnancy by itself, or systemic illness. Fourth, Remdesivir was not administered since it was not available in the Dominican Republic at the time of these patients' admission.

Conclusions

Most of the studies on COVID-19 have described its CV effect in non-pregnant women. Our study illustrates the abnormal findings of pregnant women with COVID-19 induced myocardial injury with left ventricular dysfunction. Patients had a mortality rate was 13.3% and which was attributed to malignant arrhythmias.

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Table and Figure Legends:

Table 1 represents the baseline and clinical characteristics of 15 pregnant women with COVID-19 induced myocardial injury.

Table 2 Demonstrate Blood tests, ECG and Radiological findings of 15 pregnant women with myocardial injury

Table 3 Demonstrates Delivery information Maternal and Infant outcomes

Table 1 represents the baseline and clinical characteristics of 15 pregnant women with COVID-19 induced myocardial injury.

Patient	Baseline Characteristic			Gestation			Hospitalization			
	Age (Years)	BMI (Kg/m2)	Chronic Diseases	GA (weeks)	GPAC	Prenatal Period	CC	CC Duration (Days)	ICU Admission	Intubated
1	31	32	None	35	4-3-0-0	Normal	SOB	12	Yes	Yes
2	33	28	None	33	3-1-1-0	Bleeding	DFM	13	Yes	Yes
3	26	26	None	36	2-0-0-1	Normal	SOB	9	Yes	Yes
4	29	30	None	29	2-0-0-1	Normal	Palpitations	9	Yes	Yes
5	22	24	None	29.5	1-0-0-0	Normal	Fatigue	8	Yes	No
6	26	29	None	32.2	5-3-1-0	Normal	SOB	6	Yes	Yes
7	36	23	None	36.5	3-0-0-3	Normal	SOB	12	Yes	Yes
8	38	31	None	33.1	2-0-1-0	Normal	SOB	12	Yes	Yes
9	32	27	None	30.4	4-0-3-0	Bleeding	SOB	13	Yes	Yes
10	35	26	None	34	2-0-0-1	Normal	SOB	13	Yes	Yes
11	19	28	None	28	1-0-0-0	Normal	SOB	13	Yes	No
12	21	27	None	23.3	1-0-0-0	Normal	DFM	11	Yes	Yes
13	33	30	None	36.2	1-0-0-0	Normal	SOB	3	Yes	Yes
14	35	29	None	33	1-0-0-0	Normal	Palpitations	9	Yes	Yes
15	32	32	None	35.4	1-0-0-0	Normal	SOB	6	Yes	Yes
Total	29.87±5.83	28±2.6	15 (100%) Previously Healthy	32.31±3.68		2 (13.3%) Prenatal Bleeding	10 (66.6%) SOB 2 (13.3%) Palpitation 2(13.3%) DFM 1 (6.6%) Fatigue	9.9±3.13	15 (100%) ICU Admission	13 (86.6%) Intubated

Mean ±SD, count (%), BMI: Body Mass Index, GA: Gestational Age, GPAC: Gravida, Para, Aborta, C-section, CC: Chief Complaint, ICU: Intensive Care Unit, SOB: Shortness of Breath, DFM: Decrease fetal movement

476 **Table 2 Demonstrate Blood tests, ECG and Radiological findings of 15 pregnant women with myocardial injury**

	Blood Test				ECG				Chest X-ray			TTE			
	COVID PCR	**COVID ELISA IGM**	**Troponin (ng/ml)**	**Pro-BNP (pg/ml)**	**Rhythm**	**BBB**	**ST Depression**	**T wave inversion**	**Consolidation**	**Ground Glass**	**CTI**	**LVEF**	**LAD**	**LVD**	**LV Diffuse Hypokinesis**
1	Positive	Reactive	14	150	Regular	Yes	Yes	Yes	Yes	Yes	0.5	37	No	No	Yes
2	Positive	Reactive	9.8	184	Regular	No	Yes	Yes	Yes	Yes	0.49	40	No	No	Yes
3	Positive	Reactive	15	209	Regular	No	No	No	Yes	No	0.5	40	No	No	Yes
4	Positive	Reactive	641	566	Irregular	Yes	Yes	Yes	Yes	Yes	0.66	22	Yes	Yes	Yes
5	Positive	Reactive	13	135	Regular	No	No	Yes	Yes	No	0.48	38	No	No	Yes
6	Positive	Reactive	189	308	Regular	No	No	No	Yes	Yes	0.5	35	No	No	Yes
7	Positive	Reactive	45	225	Regular	No	No	No	Yes	No	0.5	39	No	No	Yes
8	Positive	Reactive	13	246	Regular	No	No	Yes	Yes	No	0.48	42	No	No	Yes
9	Positive	Reactive	12	233	Regular	No	No	No	Yes	No	0.49	44	No	No	Yes
10	Positive	Reactive	55	144	Regular	No	No	No	Yes	No	0.45	37	No	No	Yes
11	Positive	Reactive	35	204	Regular	Yes	Yes	No	Yes	No	0.44	45	No	No	Yes
12	Positive	Reactive	20	243	Regular	Yes	Yes	No	Yes	No	0.48	38	No	No	Yes
13	Positive	Reactive	35	166	Regular	No	No	No	Yes	Yes	0.49	43	No	No	Yes
14	Positive	Reactive	750	423	Irregular	Yes	Yes	Yes	Yes	Yes	0.68	25	Yes	Yes	Yes
15	Positive	Reactive	44	198	Regular	No	No	No	Yes	No	0.46	40	Yes	No	Yes
Total	5 (100%) PCR Positive	15 (100%) Reactive	15 (100%) Elevated Troponin	15 (100%) Elevated Pro-BNP	2 (13.3%) Irregular Rhythm	5 (33%) BBB	6 (40%) ST Depression	6 (40%) T inversion	15 (100%) Consolidation	6 (40%) Ground Glass	0.5	37± 6	3 (20%) LAD	2 (13.3%) LVD	15 (100%) LV Diffuse Hypokinesis
	All patients have COVID-19 with elevated cardiac enzymes				8 (53.3%) had abnormal ECG, 7 (46.6%) had a normal ECG				All patients had Abnormal Chest X-ray			All patients had abnormal TTE with LV dysfunction			

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478 *Mean ±SD, count (%),* CTI: Cardiothoracic Index, *LVEF: Left ventricular ejection fraction, LAD: Left atrial dilation, LVD: Left ventricular dilation, LV:*
479 *left ventricle, BBB: Bundle Branch Block*
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481 **Table 3 Demonstrates Delivery information Maternal and Infant outcomes**

Patient	Delivery			Outcome		Infant				
	GA (weeks)	Mode of Delivery	Reason for Delivery	Maternal	Infant	Length (cm)	Weight (Kg)	APGAR At 0/5 min	APGAR Interpretation	NICU Admission
1	37	C-Section	Clinical Instability	Recovered	Healthy	47	2.9	7/8	Normal	No
2	35.3	C-Section	Clinical Instability	Recovered	Healthy	45	2.3	6/8	Moderate Depressed/Normal	No
3	38	C-Section	Prior c-section	Recovered	Healthy	47	2.6	8/9	Normal	No
4	29	C-Section	Fetal Bradycardia	Death	Healthy	37	1.2	5/6	Moderate Depressed/ Normal	Yes
5	33	C-Section	Clinical Instability	Recovered	Healthy	42	2.1	5/6	Moderate Depressed	Yes
6	35.2	C-Section	Clinical Instability	Recovered	Healthy	48	2.9	7/8	Normal	No
7	39	C-Section	Prior c-section	Recovered	Healthy	48	3	7/8	Normal	No
8	35.2	C-Section	Clinical Instability	Recovered	Healthy	48	2.7	7/8	Normal	No
9	32	C-Section	Clinical Instability	Recovered	Healthy	43	1.7	5/6	Moderate Depressed	Yes
10	37	C-Section	Prior c-section	Recovered	Healthy	47	2.5	7/8	Normal	No
11	31	C-Section	Clinical Instability	Recovered	Healthy	42	1.5	5/6	Moderate Depressed	Yes
12	23.3	C-Section	Clinical Instability/Fetal Bradycardia	Recovered	Death	26	0.3	0	-	
13	38	C-Section	Clinical Instability	Recovered	Healthy	49	3.1	7/8	Normal	No
14	33.3	C-Section	Fetal Bradycardia	Death	Healthy	43	1.9	6/8	Moderate Depressed/Normal	Yes
15	37	C-Section	Clinical Instability	Recovered	Healthy	49	3	7/8	Normal	No
Total	34.2±4	15 (100%) c-section	9 (60%) Clinical Instability 3 (20%) Fetal Bradycardia 3(20%) Prior c-section	2 (13.3%) Maternal Death	1 (6.6%) Fetal Demise	44±5	2.2±0.7	8 (57%) had a normal APGAR at 0 and 5 min 3 (21.5%) had a moderate depressed APGAR at 0 and a normal at 5 min 3 (21.5%) had a moderate depressed APGAR at 0 and 5 min		5 (35.7%) NICU Admission

482 *Mean ±SD, count (%), GA: Gestational Age, APGARD: Activity, Pulse, Grimace, Appearance, Respiration, NICU: Neonatal Intensive Care Unit, C-*
483 *Section: Cesarian section*
484 *Normal APGAR: 7-10, Moderate Depressed APGAR: 4-6, Severe Depressed APGAR: 0-3*
485