

# Myopericarditis and COVID-19: a systematic review of cases

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## Discussion

We recently published a systematic review on the electrocardiographic (ECG) findings in patients with coronavirus disease-19 (COVID-19) [1]. In the abovementioned study, we observed myopericarditis as one of the possible patterns of cardiac involvement in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection. Earlier studies show that myopericarditis was most frequently linked to post-viral inflammations

with different viruses, and SARS-CoV-2 might be another virus causing this condition [2]. Therefore, we aimed to closely inspect the published studies (mostly case reports) regarding this pattern.

We systematically searched PubMed (29 results), Embase (26 results), Scopus (25 results), and Cochrane (no results) databases for the following key-terms: "Myopericarditis" and "COVID-19", "SARS-CoV-2", "SARS-CoV2", "2019-nCoV" or "Novel coronavirus." We included the original studies investigating myopericarditis in patients with COVID-19. Articles without a retrievable full-text were excluded, including abstracts and conference abstracts.

We found a total of 24 cases in 20 studies (19 case reports and a case series). Among the 19 patients with available age, gender, and comorbidity data, 10 (52.6%) were female. The mean age was  $50.6 \pm 8.9$ , with one of the cases being a pediatric patient [3]. Seven (36.8%) had no known previous comorbidities. Two patients had a history of previous myopericarditis [4,5]. Of these 19 patients, eight (42.1%) and 10 (52.6%) presented with chest pain and dyspnea respectively.

Ten of 21 patients (47.6%) with ECG data had typical or mostly-typical findings of pericarditis: diffuse ST elevations with PR depressions in non-aVR leads and reverse changes in the aVR. In 14 cases with reports of left ventricular (LV) function on echocardiography, a decreased LV ejection fraction (LVEF) (LVEF <50% (6, 7)) was observed in 7/14 (50%). Five of 24 (20.8%) patients developed cardiac tamponade, and 4/24 (16.7%) died. Table 1 presents patient characteristics, symptoms, physical examinations,

Table 1: Summary of the findings in the included studies

Study (Ref)	Patient characteristics and comorbidities	Symptoms on admission	Physical examination	1) ECG* and 2) cardiac biomarkers at presentation	Echocardiographic findings	Complication	Management
3	1-year-10-month-old girl with no previous cardiovascular history	Persistent fever,	1) Vital signs: HR: 120 bpm, RR: 26, SpO <sub>2</sub> : 92%, T: 38.6 °C	1) N/A	Normal cardiac chambers size,	Pericardial thickening, minor effusion without signs of tamponade; survived	Antibiotics (azithromycin, ampicillin/sulbactam), paracetamol, and intravenous hydration
		conjunctivitis, generalized rash, edema in eyelids, hands, and feet, general discomfort, occasional cough, and light arthralgia.	2) Heart: normal sounds and rhythm, no murmurs.	2) Troponin T: 29.1 pg/ml	normal diameter of coronary arteries, and		
			3) Lungs: preserved vesicular murmur.	CK-MB; 18.1 ng/ml	light pericardial effusion more evident in right chambers, without signs of cardiac tamponade		
4	47-year-old woman with previous myopericarditis	Chest pain, breathlessness, dry cough, and subjective fevers	1) Vital signs:	1) Sinus tachycardia and concave infero-lateral ST elevation	Initial echocardiogram: normal LV function and a global pericardial effusion with a	Cardiac tamponade; survived	Pericardiocentesis, IV fluid resuscitation, transferred to the ITU for vasopressor support.
			BP: 80/50, HR: 110, T: 36.9 °C	2) Troponin T levels were 225 and 253 ng/L.	maximum depth of 1.1 cm and no tamponade, Repeat		
					echocardiogram: further accumulation of		
					pericardial effusion to a maximal depth of 2 cm, with evidence of cardiac tamponade		

5	50-year-old woman with a history of hypertension, reactive arthritis, and previous myopericarditis in 2012	Central chest pain (worse on lying flat and deep inspiration), without dyspnea and cough	1) Vital signs: BP:116/74 mmHg, HR: 85 bpm, SatO2: 97%, afebrile	1) Poor R-wave progression and small QRS complexes	Trivial anterior pericardial effusion with good biventricular function	Myopericarditis, myositis; survived	Colchicine, ibuprofen, and prednisolone
			2) Heart: normal	2) Troponin T: 77 ng/L			
			3) Lungs: normal				
			Examination findings were normal				
9	60-year-old man with no comorbidities	Severe ongoing asthenia for a week, and acute anosmia	1) Stable hemodynamic parameters, T= 39°C, no need for oxygen therapy.	1) Normal sinus rhythm and flattened T waves in lateral leads	N/A	COVID-19 myopericarditis, AF; survived	Colchicine,
			2) The physical examination was normal	2) High-sensitivity cardiac troponin I peak: 639 ng/L			Flecainide.
							Discharged with maintenance dose of colchicine
12	38-year-old woman with no comorbidities	Palpitations and general malaise without dyspnea, chest pain, or respiratory symptoms	1) Vital signs: HR: 137 bpm, BP: 98/54, SpO2: 95%, T: 36.5 °C	1) Diffuse concave ST elevation,	Global LV hypokinesia, severely reduce LV systolic function (LVEF <30%), mild pericardial effusion (2 mm), no valvular disease	Fulminant myocarditis with stage B cardiogenic shock, COVID-19 pneumonia; survived	ICU admission, O <sub>2</sub> supplementaion, methylprednisolone, IVig, HCQ, azithromycin, lopinavir/ritonavir, norepinephrine, dobutamine, and levosimendan; Furosmide
			2) Heart: Tachycardia without elevated JVP or heart murmurs	PR segment depression, Spodick's sign			
			3) Lungs: Bibasal soft inspiratory crackles	2) Troponin I: 1,190 ng/L, BNP: 13,000 pg/ml			
13	25-year-old man with no comorbidities	Acute-onset chest pain, dyspnea, fatigue and fever	1) Vital signs	1) Sinus tachycardia with ST segment elevation and PR depression in leads I, aVL, and V5-V6, and	Diffuse LV hypokinesia with EF= 35%, and PAP= 30 mmHg	Myopericarditis; survived	Ampicillin-sulbactam, clarithromycin, oseltamivir, acetylsalicylic acid, metoprolol
			BP: 130/80, HR: 140 bpm, SpO2: 98%, T: 37.1 °C	ST depression and PR elevation in aVR			
			2) Lungs: coarse crackles in the both lower lungs	2) Troponin: 21.471 ng/m, CK-MB: 37.1 ng/mL, troponin I: 6.499 ng/mL			

14	60-year-old male with hypertension	fevers, cough, and worsening dyspnea, with	1)Vital signs:	1) Diffuse ST elevation, with QTc interval= 437 ms	Severe segmental LV systolic dysfunction (EF= 15–20%) with hypokinesia of the apex, distal anterior septum, anterior and lateral walls, with a small pericardial effusion. Normal RV size and function.	Myopericarditis, acute	IVIg, methylprednisolone, intubation, HCQ, epinephrine
	and hyperlipidemia	mild abdominal pain and diarrhea, without chest pain, nausea, or vomiting	T: 37.4, HR: 96 bpm, SpO2: 87%,	2) LDH: 588 U/L, High-sensitivity troponin: 582 ng/L, CK-MB: 28.2 ng/mL, pro-BNP: 15642 pg/mL		hypoxemic respiratory failure; survived	
			2) Lungs: clear lungs and tachypnoea				
15	39-year-old man with no comorbidities	Chest pain, dyspnea, without fever or cough	N/A	1) Diffuse ST elevation and PQ depression	Moderate circumferential pericardial effusion, without any sign of tamponade	Myopericarditis, rhabdomyolysis, acute liver injury, pleural effusion (exudative), an episode of paroxysmal AF, mild acute	Colchicine, low doses of diuretics, insulin, fluid restricted diet, amiodarone
				2) Troponin: 15.4 µg/L, NT-pro-BNP: 4473 pg/mL		renal failure; survived	
16	71-year-old woman with a history of breast cancer	Flu-like symptoms, mild fever (38 °C), chest pain,	1) Vital signs:	1) Diffuse inverted T waves and elongated	Infero-septal and infero-apical LV wall hypokinesia, LVEF= 56%, and a	Acute myopericarditis (moderate pericardial effusion); survived	N/A
	treated with surgery, chemotherapy, radiotherapy, and hormonotherapy		SpO2: 91%, T: 38 °C	QT up to 700 ms	moderate pericardial effusion		
				2) High-sensitivity troponin T: 60 ng/L, BNP: 474 ng/L			
17	78-year-old man with hypertension	chest pain and dyspnea	N/A	1) AF with 150 beat/min and concave ST elevation except for aVR lead	N/A	Acute respiratory distress, mild pericardial effusion; survived	Intubation, Furosemide, beta-blocker, ACE inhibitor,
				2)Troponin T: 998.1 ng/L			COVID-19 specific therapy

18	50-year-old man with hypertension and past history of ischemic stroke	fevers, chills, generalized malaise, non-productive cough, dyspnea for 3-4 days and an episode of near-syncope	N/A	1) Sinus tachycardia, ST elevation in II, III, and	Severe global LV systolic dysfunction,	ACS, purulent fulminant myopericarditis, cardiac tamponade, circulatory shock, acute hypoxemic	Intubation, Mechanical ventilator, Pericardiocentesis, vasopressin, norepinephrine, dobutamine, HCO <sub>3</sub> , azithromycin, Vancomycin, Cefepime, IVIg, methylprednisolone, Methylene blue, Remdesivir
				aVF and ST-depression in I and aVL	RV enlargement and systolic dysfunction, Moderate-to-large pericardial effusion anterior to the RV with	respiratory failure, AKI, gastrointestinal bleeding, multi-organ failure; Expired	
				2) LDH: 3332 U/L, high	organizing material (suggesting an inflammatory process),		
				sensitivity troponin: 544 ng/L, creatine kinase: 2135 U/L, CK-MB: 54.3 ng/mL	intermittent RV impaired filling and collapse suggestive of tamponade physiology		
19	53-year-old woman with no comorbidities	Fever, dry cough, severe fatigue, without chest pain, dyspnea, and further symptoms. The patient did not show any respiratory involvement during the clinical course.	1) Vital signs:	1) Low voltage in the limb leads, minimal diffuse ST-segment elevation (more prominent in the inferior and lateral leads), and	Regional wall motion abnormalities, normal LV dimensions with increased wall thickness	Acute myopericarditis (pericardial effusion) with systolic dysfunction; survived	Dobutamine, antiviral drugs (lopinavir/ritonavir),
			BP: 90/50, HR: 100 bpm, SpO <sub>2</sub> : 98%, T:36.6 °C	ST-segment depression with T-wave inversion in V1 and	(interventricular septum: 14 mm, posterior wall: 14 mm),		steroids, chloroquine, kanrenone, furosemide, bisoprolol, kayexalate, glucose and insulin solution, sodium bicarbonate, aspirin
				aVR	diffuse echo-bright appearance of the myocardium, diffuse hypokinesis, estimated LVEF= 40%, no evidence of heart valve disease,		
				2) Troponin T: 0.24	midly impaired LV diastolic function with		
				ng/mL, CK-MB: 20.3 ng/mL, NT-pro-BNP: 5647 pg/mL	mitral inflow patterns, an E/A ratio of 0.7 and an average		
					E/e' ratio of 12, circumferential pericardial effusion most notable around the right cardiac chambers (maximum, 11 mm), without signs of tamponade.		

20	51-year-old man with a history of hypertension.	Dry cough, fatigue,	1) Vital signs:	1) Diffuse ST elevation	Enlarged heart with a marked decrease in ventricular	Fulminant	HCO,
		dyspnea, fever, multiple episodes of	T: 39.6 °C, RR: 26, BP: 141/89, HR: 97 bpm, SpO2: 91%	2) Troponin: 18 ng/mL, CK-MB: 14.7 ng/mL, BNP: 1,287 pg/mL	systolic function (EF= 20%)	myopericarditis, ARDS with bilateral pleural effusion; expired	azithromycin, dobutamine, remdesivir, ventilatory support,
		epigastric pain and nausea partially improved with omeprazole treatment two days prior to	2) Lungs: bilateral wheezing and rhonchi, agonal respiration, and a symmetrical decrease in chest				acetaminophen IV drip, ceftriaxone, vancomycin, remdesivir, dobutamine, indomethacin, Intravenous
		hospitalization. No chills,	expansion.				methylprednisolone, and colchicine
		diaphoresis, chest pain, or change in bowel or urinary habits.	3) Heart: pericardial friction rub (in day 7 of hospitalization)				
21	58-year-old woman on a background of	Fever, diarrhea and vomiting and poor oral intake	1) Vital signs:	1) N/A	1.5 cm pericardial effusion initially, over	Cardiogenic shock, and	Pericardial drain, vasopressor support in the ITU,
	type 2 Diabetes and Hypertension	with no respiratory symptoms	BP: 85/45, RR: 18, SpO2: 96%, HR: 91 bpm, T: 34.7 °C	2) Raised LDH, High sensitivity troponin: 388.8 ng/L,	7 hours the effusion progressed to 3–4 cm with evidence of cardiac tamponade	cardiac tamponade; survived	IV Amoxicillin and oral Doxycycline initially, then escalated to Piperacillin/Tazobactam,
			2) Heart: raised JVP and pulsus paradoxus				furosemide
			3) Abdomen: generalized				
			abdominal tenderness				
22	61-year-old man with obesity	5 days of progressive dyspnea leading to respiratory failure and severe hypoxemia	Hemodynamic and pulmonary instability	1) Diffuse concave elevation of the ST segment	Day 1: Severe RV dysfunction with paradoxical movement of the septum due to overload of the right chambers,	Acute myopericarditis, severe COVID-19 pneumonia, massive pulmonary thromboembolism of both main pulmonary arteries; survived	ICU admission, O <sub>2</sub> supplementation
				2) N/A	in addition to severe TR suggesting pulmonary embolism		
					Day 7: Normal LVEF with		
					Mild to moderate pericardial effusion		

23	82-year-old woman with hypertension, hyperlipidemia, iron-deficiency anemia, and paroxysmal AF, tachycardia-bradycardia syndrome	5 days of productive cough, fever with chills, intermittent diarrhea, without angina symptoms	1) Vital signs: afebrile, hemodynamically stable, and in no respiratory distress	1) Atrial paced rhythm with diffuse new, prominent T-wave inversions and a prolonged QT interval (>500 ms)	Day 1: LVEF= 55%, small circumferential pericardial effusion, and apical hypokinesis	COVID-19-induced inflammatory myopericarditis and pericardial effusion, cardiac tamponade; survived	No ICU admission or mechanical ventilation; physical isolation, antipyretics, hydration, and O <sub>2</sub> supplementation
				2) mildly elevated troponin I (peaked at 0.037 ng/ml)	Day 6: a moderately enlarging pericardial effusion with left pleural effusion		
					Day 8: circumferential pericardial effusion that had further enlarged since the previous study, a RV pacemaker wire 'piercing' the RV apex alongside early diastolic collapse of the right ventricle, suggesting echocardiographic tamponade		
24	5 patients	Respiratory failure requiring invasive ventilation	N/A	1) No significant characteristics of a myopericarditis	Pericardial effusion without signs of cardiac tamponade located predominantly around the right atrium and ventricle, presence of a quasi-floating fiber-like structure within the right-sided segment of the atrioventricular sulcus, and RV dilatation in 3/5 cases with PAP of 39, 35, 30 mmHg, respectively	COVID-19 associated myopericarditis, n=5;	ICU admission
	(Age, gender, comorbidities: N/A)			2) Increased high-sensitivity troponin I: 5/5	Survived, n=3,		
					Expired, n=2		
25	19-year-old woman with no comorbidities	Fever, chest pain and cutaneous rash	1) Vital signs:	1) Sinus tachycardia and diffuse ST-segment elevation;	Normal ventricular function, with no signs of pericardial effusion	COVID-19 associated acute myopericarditis; survived	Ceftriaxone, LMWH, acetylsalicylic acid, pantoprazole, HCQ, lopinavir/ritonavir (antiviral and HCQ therapy was discontinued after 2 days because of nausea, diarrhea and anemia) Colchicine
			HR: 120 bpm,	2) Troponin T: 367 ng/L			
			T: 38.5 °C,				
			SpO <sub>2</sub> : 97% in ambient air				
			2) Thorax and abdominal examination: normal.				
3) Skin examination: showed a rash consisting in slightly erythematous confluent macules, involving the trunk and the limbs. On the palms and soles the macules merged into sharply edged areas of erythema with islands of spared skin							

26	73-year-old man with hypertension, dyslipidemia, type 2 diabetes mellitus, COVID-19 pneumonia and former nicotine dependence	Pressure-like, non-radiating and constant chest pain, 7 out of 10 in severity, started 3 hours prior arrival, worsened by deep breathing and movement, dyspnea on minimal exertion	1) Vital signs: within normal limits except for heart rate fluctuating between 100 to 110 bpm	1) Concave shaped ST elevations in leads I, II, aVF, V2-V6 of different magnitudes, with reciprocal ST depression seen in lead aVR, PR segment depression, Spodick's sign on V3 to V5	Small pericardial effusion,	COVID-19 associated acute myopericarditis (6-8 weeks after COVID-19 positive test); survived	N/A	
				2) Elevated troponin I	grade I diastolic dysfunction, LVEF between 40-50%, increased wall thickness, and concentric hypertrophy			
27	45-year-old woman with no comorbidities	Progression of dyspnea, fever, myalgia and postural hypotension	Vital signs:	1) N/A	Normal biventricular function, with moderate pericardial effusion and diastolic restriction of the right ventricle	Fulminant COVID-19 associated myopericarditis, pleural effusion, cardiac tamponade and arrest; survived	Antibiotic therapy with azithromycin, piperacillin/tazobactam and teicoplanin, ICU admission, unsuccessful pericardiocentesis followed by emergency thoracotomy, internal cardiac compression and pericardial drainage, noradrenaline, dobutamine, milrinone and vasopressin,	
				HR: 125 bpm,	2) Initial troponin I: 867 pg/mL			venoarterial ECMO,
				BP: 105/72 mmHg, RR: 26 breaths/min and SpO <sub>2</sub> :100% on room air	peak troponin levels reached 14,000 pg/mL			tocilizumab,
					Initial BNP: 1840 pg/mL			immunoglobulin,
								convalescent plasma,
								methylprednisolone, UFH infusion

electrocardiographic and ECG findings, and subsequent complications and management.

Overall, myopericarditis seems to be a rare complication of COVID-19. Direct and indirect mechanisms can explain this pathology in the patients [8,9]. Viral entry through cardiac angiotensin-converting enzyme II (ACE-II) might directly cause myopericarditis [10]. Indirect injuries might result from the cytokine storm precipitated by the immune response to the virus and immune-cell recruitment [9,11]. This condition's incidence was not precisely studied, and future studies need to decipher the unknowns surrounding the subject.

**Keywords:** Anorectal disorders • Prevalence • Nepal

**Abbreviations:** ECG: Electrocardiography; HR: Heart rate; BPM: Beats per minute; BP: Blood pressure; SpO<sub>2</sub>: O<sub>2</sub> saturation; T: Temperature; N/A: Not available; LV: Left ventricular; IV: Intravenous; AF: Atrial fibrillation; ITU: Intensive treatment unit; JVP: Jugular venous pressure; BNP: B-type natriuretic peptide; LVEF: Left ventricular ejection fraction; ICU: Intensive care unit; IVIg: Intravenous immunoglobulin; HCQ: Hydroxychloroquine; CK-MB: Creatinine kinase-MB; EF: Ejection fraction; PAP: Pulmonary artery pressure; RV: Right ventricle; ACE: Angiotensin-converting enzyme; ACS: Acute coronary syndrome; AKI: Acute Kidney injury; ARDS: Acute respiratory distress syndrome; ECMO: extracorporeal membrane oxygenation; LMWH: low-molecular weight heparin; RR: respiratory rate; TR: tricuspid regurgitation; UFH: unfractionated heparin.

**References**

- Mehraeen E, Seyed Alinaghi S, Nowroozi A, Dadras O, Alilou S, et al. A systematic review of ECG findings in patients with COVID-19. *Indian Heart Journal* (2020).
- Di Tano G, et al. Implications for the Care of Patients With COVID-19 and Inflammatory Myocardial Disease. *JAMA cardiology*. (2020);5: 1305-1306.
- Jorge AR, et al. Myopericarditis and skin rash in a patient with COVID-19 infection. *Revis Bionatura*. (2020)5: 1253-1256.
- Hua A, et al. Life-threatening cardiac tamponade complicating myopericarditis in COVID-19. *European heart journal*. (2020);41: 2130.
- Shabbir A, Camm CF, Elkington A, Tilling L, Stirrup J, et al. Myopericarditis and myositis in a patient with COVID-19: a case report. *European heart journal Case reports*.(2020);4: 1-6.
- Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JGF, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. *European heart journal*. (2016);37(27):2129-200.
- Yancy Clyde W, Jessup M, Bozkurt B, Butler J, Casey Donald E, et al. 2013 ACCF/AHA Guideline for the Management of Heart Failure. *Circulation*. (2013);128: e240-e327.

8. Dong N, Cai J, Zhou Y, Liu J, Li F, et al. End-Stage Heart Failure With COVID-19: Strong Evidence of Myocardial Injury by 2019-nCoV. *JACC Heart failure*. (2020);8: 515-517.
9. Sauer F, Dagrenat C, Couppie P, Jochum G, Leddet P, et al. Pericardial effusion in patients with COVID-19: case series. *European heart journal Case reports*. (2020);4: 1-7.
10. Jin Y, Yang H, Ji W, Wu W, Chen S, et al. Virology, Epidemiology, Pathogenesis, and Control of COVID-19. *Viruses*. (2020);12.
11. Xu Z, Shi L, Wang Y, Zhang J, Huang L, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. *The Lancet Respiratory medicine*. (2020);8: 420-422.
12. Bernal-Torres W, et al. COVID-19 fulminant myocarditis: a case report. *European heart journal Case reports*. (2020);4: 1-6.
13. Özturan İ U, et al. Myopericarditis caused by severe acute respiratory syndrome coronavirus 2. *Clinical and experimental emergency medicine*. (2020);7: 326-329.
14. Li A, et al. Management of COVID-19 myopericarditis with reversal of cardiac dysfunction after blunting of cytokine storm: a case report. *European heart journal Case reports*. (2020);4: 1-6.
15. Legrand F, et al. Myopericarditis, Rhabdomyolysis, and Acute Hepatic Injury: Sole Expression of a SARS-CoV-2 Infection. *Circulation Cardiovascular imaging*. (2020);13: e010907.
16. Labani A, Germain P, Douchet MP, Beghi M, Von Hunolstein JJ, et al. Acute Myopericarditis in a Patient With Mild SARS-CoV-2 Respiratory Infection. *CJC open*. (2020);2: 435-437.
17. Cizgici AY, et al. COVID-19 myopericarditis: It should be kept in mind in today's conditions. *The American journal of emergency medicine*. (2020);38: e5-.e6.
18. Khatri A, et al. Coronavirus disease 2019 (Covid-19) presenting as purulent fulminant myopericarditis and cardiac tamponade: A case report and literature review. *Heart & Lungs : the journal of critical care*. (2020);49: 858-863.
19. Inciardi RM, Lupi L, Zaccone G, Italia L, Raffo M, et al. Cardiac Involvement in a Patient With Coronavirus Disease 2019 (COVID-19). *JAMA cardiology*. (2020);5: 819-824.
20. Hussain H, et al. Coronavirus (COVID-19) Fulminant Myopericarditis and Acute Respiratory Distress Syndrome (ARDS) in a Middle-Aged Male Patient. *Cureus*. (2020);12: e8808.
21. Cairns L, et al. COVID-19 myopericarditis with cardiac tamponade in the absence of respiratory symptoms: a case report. *Journal of medical case reports*. (2021);15: 31.
22. Pérez-Acosta G, et al. COVID-19 myopericarditis: A case report. *Revista clinica espanola*. (2021).
23. Purohit R, Kanwal A, Pandit A, Patel BM, Meininger GR, et al. Acute Myopericarditis with Pericardial Effusion and Cardiac Tamponade in a Patient with COVID-19. *The American journal of case reports*. (2020);21: e925554.
24. Rauch S, Regli IB, Clara A, Seraglio PM, Bock M, et al. Right ventricular myopericarditis in COVID-19: a call for regular echocardiography. *Minerva anesthesiologica*. (2020);86(11): 1253-1254.
25. Recalcati S, Piconi S, Franzetti M, Barbagallo T, Prestinari F, et al. Colchicin treatment of COVID-19 presenting with cutaneous rash and myopericarditis. *Dermatologic therapy*. (2020);33: e13891.
26. Rivera-Morales MD, Pell R, Rubero J, Ganti L. Acute Myopericarditis in the Post COVID-19 Recovery Phase. *Cureus*. (2020);12: e11247.
27. Sampaio PPN, Ferreira RM, Albuquerque FN, Colafranceschi AS, Almeida ACP, et al. Rescue venoarterial extracorporeal membrane oxygenation after cardiac arrest in COVID-19 myopericarditis: A case report. *Cardiovascular revascularization medicine : including molecular interventions*. (2020).