Post COVID-19 Pericarditis: The Role of Cardiovascular Magnetic Resonance Imaging

Rabab Mohamed Abdelhay, MD[1], Ahmed M.W.Algebally, MD PhD[1], Samar Mohamed Shehata ,MD, PhD[1], Mohamed S Elgammal, MD[2], Sara Kamel Eldemerdash, MSc[1], Mohammad Walaa, MD[2], Shaimaa Elsayed Badr, MD[1].

1 Radio-diagnosis department, Faculty of Human Medicine, Zagazig University, Zagazig, Egypt.

2 Chest diseases department, Zagazig university, Zagazig, Egypt.

Corresponding author: Sara Kamel Eldemerdash

E-mail: Sarakamel2018@medicine.zu.edu.eg, sarakamelsaid@gmail.com

Conflict of interest: None declared.

Funding: No funding sources

Abstract

Pericarditis, an inflammation of the pericardium, is a recognized complication of COVID-19. Cardiac magnetic resonance imaging (MRI) is a valuable diagnostic tool for evaluating pericardial inflammation. However, there is limited literature on the use of cardiac MRI in post-COVID pericarditis. The aim of the article is to evaluate the utility of cardiac MRI in diagnosing and characterizing post-COVID pericarditis.

Keywords: CMR, COVID-19, pericarditis.

Tob Regul Sci.™ 2022 ;8(2): 728 - 733

DOI: doi.org/10.18001/TRS.8.2.51

Introduction

COVID-19, caused by the SARS-CoV-2 virus, primarily affects the respiratory system but can also involve other organs and systems in the body [(1)].

Pathophysiology of post COVID-19 cardiac involvement

Molecular Level: The SARS-CoV-2 virus is an enveloped, positive-sense, single-stranded RNA virus belonging to the coronavirus family. It gains entry into host cells by binding to the angiotensin-converting enzyme 2 (ACE2) receptor, which is expressed in various tissues, including the respiratory tract, heart, kidneys, and gastrointestinal tract **(Fig 1)** [(2)]. Cellular Level: Upon entering the host cell, the virus releases its RNA genome and hijacks the host cell's machinery to replicate its genetic material and produce viral proteins. The viral spike protein, in particular, plays a crucial role in the pathogenesis of COVID-19 by facilitating viral entry and potentially triggering an immune response [(3)]. Tissue Level: Viral replication in the involved cells leads to cytopathic effects, including cell damage, necrosis, and apoptosis. This damage results in inflammation,

immune cell infiltration, and the release of pro-inflammatory cytokines, collectively known as a cytokine storm [4].

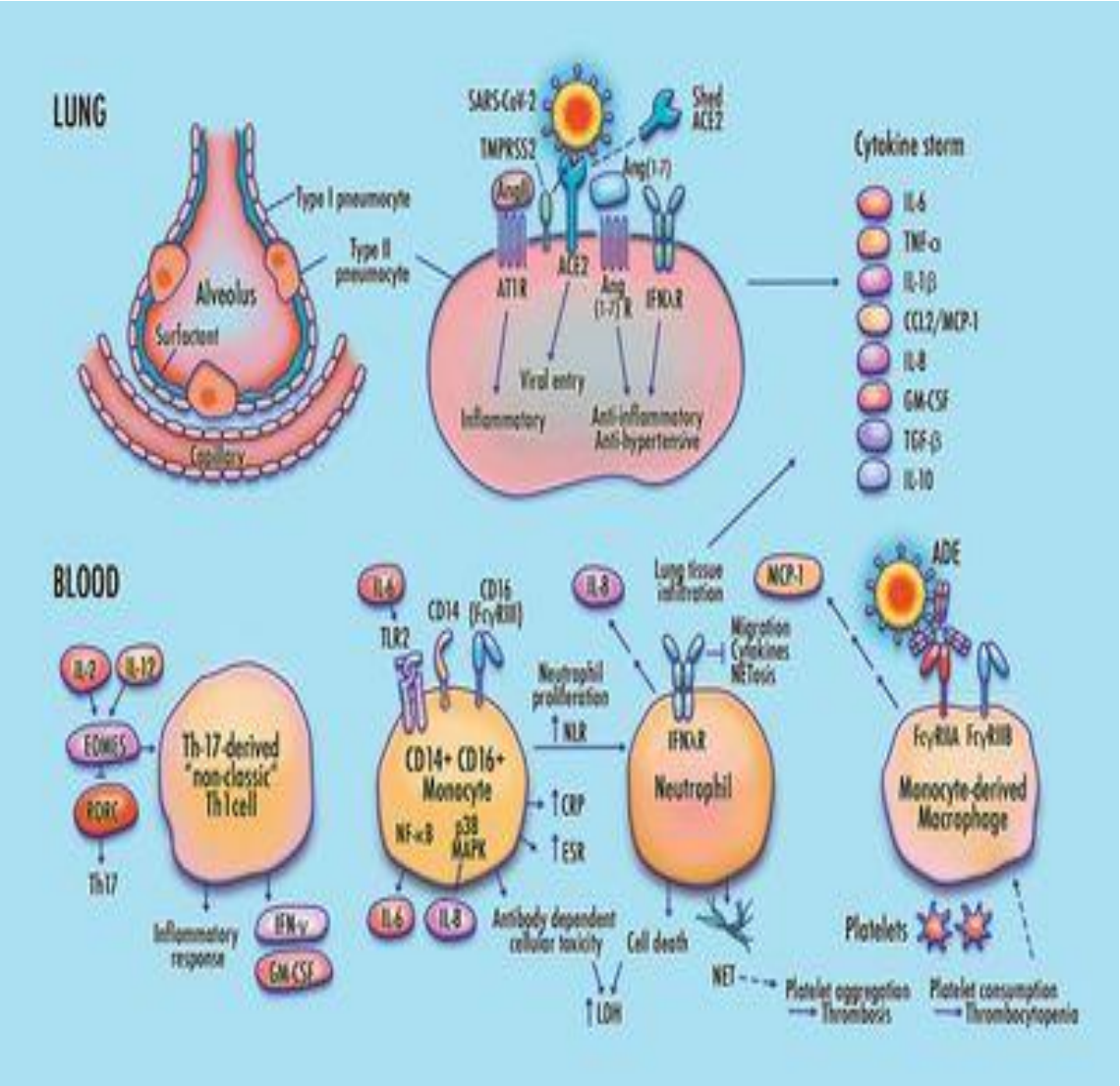

Figure 1: Molecular and cellular pathophysiology in COVID 19 (Quoted from 4).

Clinical picture of COVID-19 related pericarditis

The clinical presentation of pericarditis in COVID-19 patients can vary greatly depending on the severity of the disease. Some common symptoms and signs associated with cardiac complications in COVID-19 patients include [3-6]*:*

Chest pain, shortness of breath, palpitations, and fatigue are common symptoms that can be indicative of cardiac complications. Chest pain can be described as tightness or discomfort, similar to angina, and may be exacerbated by physical exertion or emotional stress. Shortness of breath can be a sign of heart failure, pulmonary embolism, or respiratory involvement [3-6].

Fever and general malaise are also common symptoms in COVID-19 patients, which can be indicative of the systemic inflammatory response or as a spectrum of pulmonary involvement [3-6].

Investigations of COVID-19 related pericarditis

Investigating COVID-19-related pericarditis requires a combination of clinical assessment, laboratory tests, and imaging studies [1]:

-**Medical History and Physical Examination:** Assessing past medical history, cardiovascular risk factors, and current symptoms [2,3,4].

-**Laboratory tests:** Cardiac Biomarkers: Measuring troponin, B-type natriuretic peptide (BNP), and N-terminal pro-B-type natriuretic peptide (NT-proBNP) to assess myocardial injury or heart failure. Other blood tests as Troponin I, D- dimer, complete blood count [2-5].

-**Cardiac imaging:**

Electrocardiogram (ECG): Detecting arrhythmias, myocardial ischemia, or changes suggestive of myocardial injury or strain [1-5].

Chest X-ray: Evaluating lung involvement and ruling out other causes of respiratory symptoms [1-5].

Echocardiography: Assessing pericardial effusion [5].

Cardiac Magnetic Resonance Imaging (CMR): Evaluating pericardial disease *(5).*

Computed Tomography (CT): Evaluating pericardial disease [5].

CMR findings in pericarditis

On top of all cardiac imaging modalities, CMR has a unique role in the assessment of pericardial diseases given its value to inform on cardiac anatomy and function and to detect pericardial thickening, inflammation, and constriction **(Figure 2)** [7].

MRI can show pericardial thickening and bright signal intensity on T2-weighted and STIR images, indicating pericardial edema. Additionally, pericardial effusion appears as a high-signal intensity space between the visceral and parietal pericardium on these sequences. LGE can help differentiate between exudative and transudative effusions. The normal pericardial thickness is considered 2 mm while a thickness of over 4 mm suggests a pericarditis **(Figure 3)** [8].

In the setting of suspected pericardial constriction, real-time cine sequences should be acquired [8].

CMR can differentiate between acute and constrictive pericarditis by more pericardial thickness (> 5mm), low T2WI signal, and lack of DHE on constrictive pericarditis **(Figure 4)** [9].

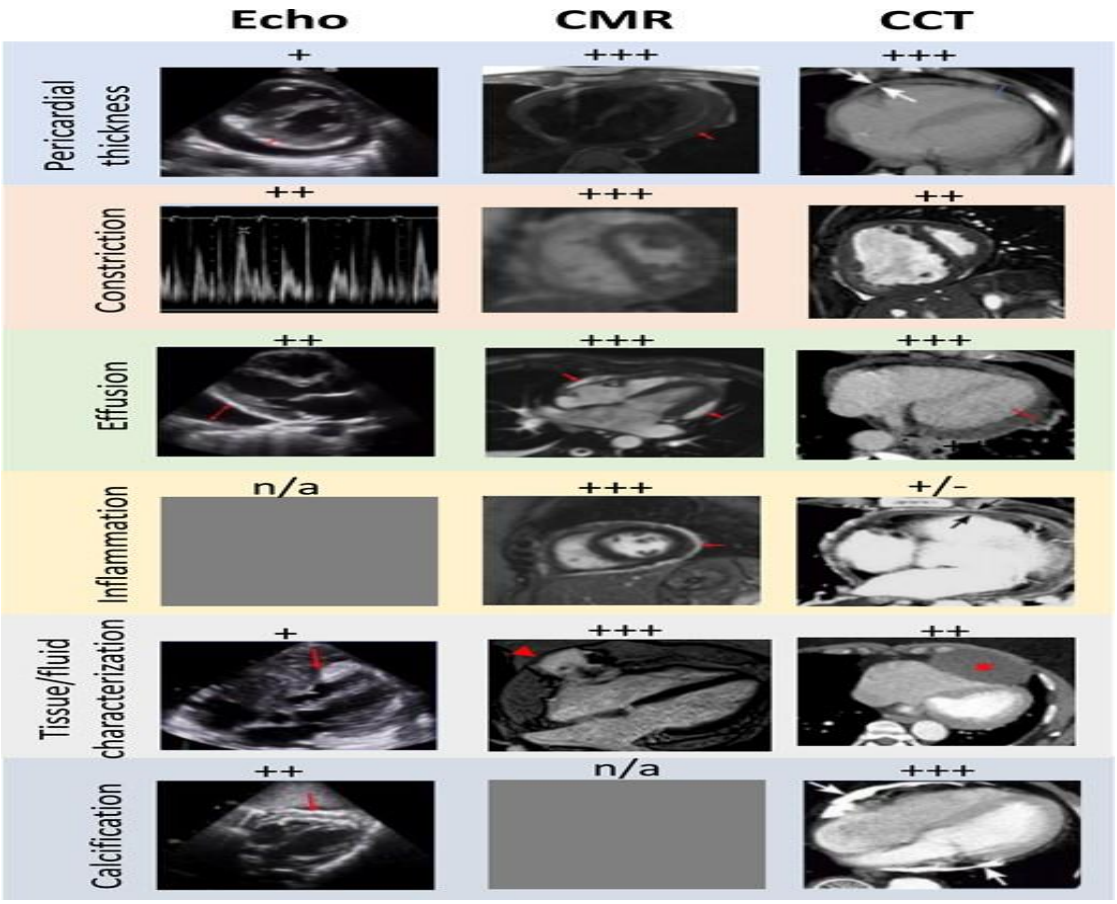

Figure 2: Strengths and weaknesses of the main imaging modalities used in the diagnosis of pericardial diseases. Echocardiography images (top to bottom): Echocardiography can show thickened visceral pericardium (red line) and pericardial effusion, respiro-phasic variation of transmitral flow (suggestive of tamponade), large pericardial effusion (red arrow), presence of masses (e.g. pericardial, and myocardial infiltration by a highly reflective tissue with nodular echo-densities, arrow) or pericardial echogenicity (arrow, suggestive of significant pericardial calcification. CMR images (top to bottom): CMR can show thickened pericardium (red arrow, T1-weighted image), inspiratory septal flattening suggestive of constriction and ventricular interdependence (free-breathing cine image), pericardial effusion (arrows, bright blood SSFP image), pericardial inflammation (arrow, LGE pericardial enhancement), or characterize masses (LGE image of a lymphoma with pericardial infiltration encasing the right coronary artery). CT images (top to bottom): contrast CT can show increased pericardial thickness (arrow), signs of constriction (paradoxical motion of the intraventricular septum, by latest generation CT scanners using retrospective triggering), visualize pericardial effusion (red line), enhancement of the pericardium in acute pericarditis (arrows, low sensitivity), presence of masses (e.g. non-enhanced large pericardial cystic lesion compressing the right ventricle, asterisk), and pericardial calcification (arrows). CMR: cardiac magnetic resonance; CT: computed tomography; LGE: late gadolinium enhancement; SSFP: steady-state free-precession (Quoted from 7).

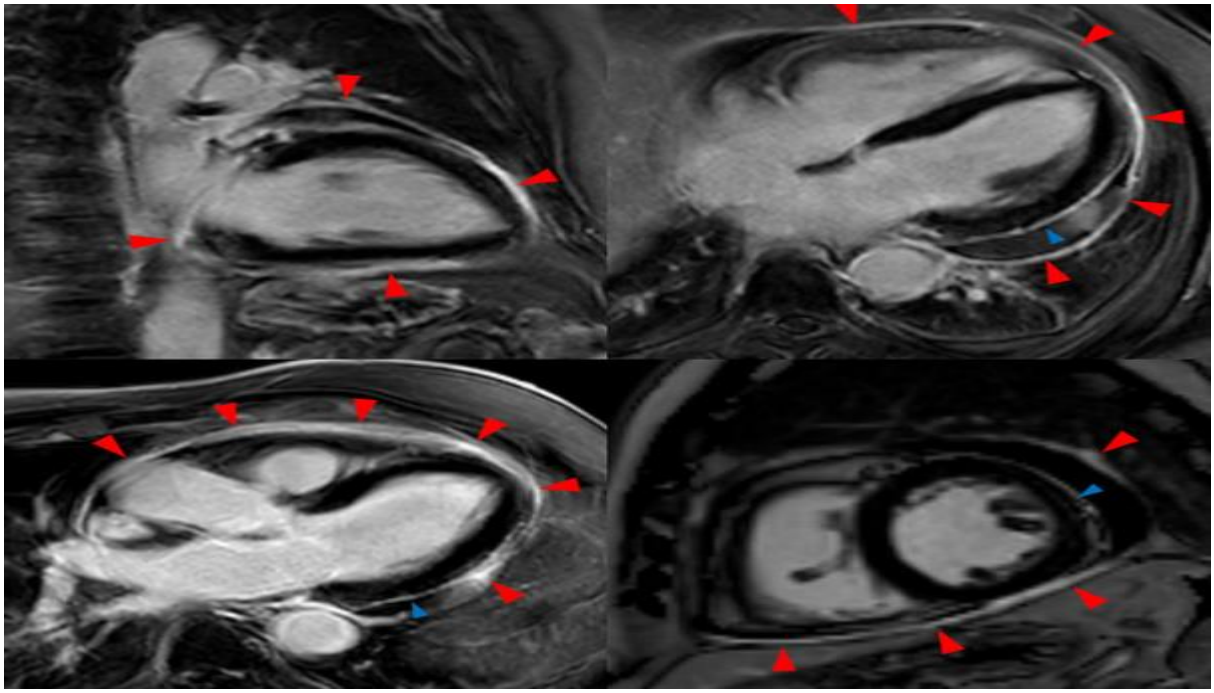

Figure 3: MRI findings of pericarditis, shows moderate pericardial effusion with pericardial thickening and enhancement of the parietal (red arrowheads) and visceral (blue arrowheads) pericardium (Quoted from 8).

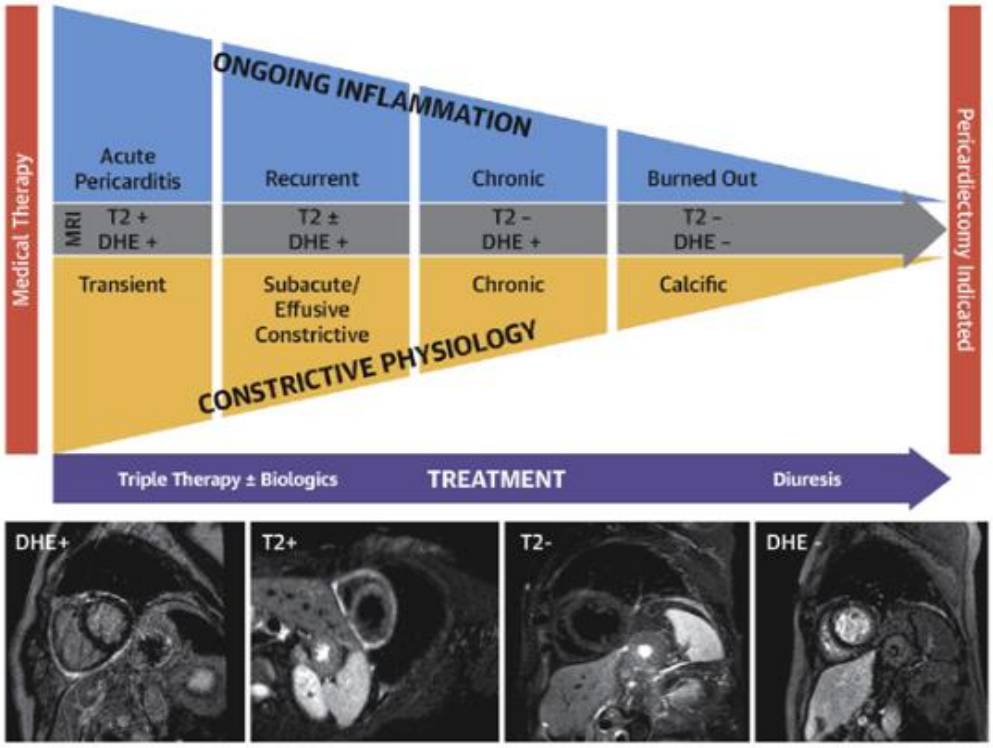

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Figure 4: CMR differences between acute and constrictive pericarditis (Quoted from 9).

Conclusion: Cardiac MRI is a valuable diagnostic tool for evaluating post-COVID pericarditis, providing detailed information on pericardial thickness, inflammation, and enhancement patterns. These findings support the use of cardiac MRI as a non-invasive alternative to echocardiography and CT scans for diagnosing and monitoring post-COVID pericarditis.

No Conflict of interest.

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