

COVID-19 and Cardiovascular Imaging: Shall We Go Beyond Echocardiography?

COVID-19 e Imagem Cardiovascular: Vamos Além da Ecocardiografia?

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Since the 1960s, different types of coronaviruses (CoVs) capable of infecting humans have been identified. Among these, the severe acute respiratory syndrome (SARS) CoV was identified more than a decade ago and has been known to cause cardiovascular complications such as acute coronary syndrome and myocardial infarction. However, limited systematic studies have been conducted on this topic.¹ Findings from previous epidemics suggest that viral infections, particularly respiratory influenza and other CoVs infections, can trigger arrhythmias and heart failure exacerbation. The recent emergence of a pandemic related to a new type of CoV, now named SARS-CoV-2, and its possible association with cardiovascular manifestations are now one of the main focuses of discussion along with known pulmonary infectious complications.

Several studies have reported increased levels of cardiac troponin levels (cardiac injury) in patients with CoV disease 2019 (COVID-19), which has been associated with a worse prognosis and increased global mortality.² Some underlying mechanisms have been proposed, such as direct myocyte injury by the viral particle, inflammatory storm as the host's immune response, and tissue hypoxia, which leads to cardiovascular manifestations such as acute myocarditis, arrhythmia, heart failure, and acute myocardial infarction of types 1 (associated with atherosclerotic plaque rupture, pro-inflammatory stimulation, and states of hypercoagulability) or 2 (mainly related to supply-demand imbalances in tissue oxygenation).¹ All these etiologies require early diagnosis and adequate management, with special attention to the increased cardiovascular risk of these patients, who are often elderly with pre-existing conditions. However, considering the rapid change in the global situation of these cases, some diagnostic gaps must be addressed until new scientific evidence-based guidelines are available.

Chest computed tomography (CT), often used to assess pulmonary parenchymal findings, when available, should be considered an opportunity for an initial cardiac investigation, especially for detecting pericardial effusion,

intracavitary thrombi, chamber dilation, or coronary calcification (reflecting previous coronary artery disease and worse prognosis). We emphasize that the absence of electrocardiographic (EKG) gating or intravenous contrast limits the assessment of cardiac structures to various degrees. However, we suggest using the synergistic characteristic of this tool to minimize the need for additional imaging tests in symptomatic patients in the context of other clinical and laboratory markers, such as low levels of troponin and B-type natriuretic peptide (BNP).

According to a document recently published by the European Society of Cardiology (ESC), the following three key points must be considered in the use of any cardiovascular imaging method in patients with COVID-19:³ (1) an investigation should be reserved for cases where a substantial change in conduct is likely or when a decision to save the patient's life is at stake; (2) the imaging modality with the best capacity to meet this request should be used, always considering the safety of the medical team regarding exposure; and (3) non-urgent, elective, or routine tests should be postponed or canceled. Accordingly, transthoracic echocardiography, despite having a central role in diagnosing underlying cardiovascular problems in patients, should not be routinely indicated in the current COVID-19 epidemic discussing the appropriateness criteria for its use is beyond the scope of this document.

Considering the acute nature of COVID-19, the clinical indications for coronary computed tomography angiography (CCTA) and cardiac magnetic resonance imaging (CMR) during the acute phase of the disease are limited and controversial.³ Coronary CCTA can exclude or confirm an acute coronary condition, elevated troponin levels, and a compatible clinical or electrocardiographic finding in patients with COVID-19 to avoid unnecessary invasive procedures. The recent recommendations of the Society of Cardiovascular Computed Tomography for the use of coronary CCTA in the context of COVID-19⁴ are described in Table 1. A recently published case of spontaneous coronary dissection in a patient with COVID-19⁵ reassures the importance of coronary angiography in selected cases, considering the invasive nature of this procedure.

In the context of potential myocardial injury related to SARS-CoV-2, another patient was recently reported to have elevated cardiac troponin levels, and CMR showed T2 mapping diffuse edema and slow gadolinium wash-out in delayed enhancement sequences, suggesting acute myocarditis.⁶ Although the pathophysiological mechanisms of

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Table 1 - Recommendations of the Society of Cardiovascular Computed Tomography for the use of coronary angiotomography in the context of COVID 19.

Degree of urgency	Clinical conditions	Examination time
Elective	Asymptomatic or stable coronary artery disease Cardiomyopathy or stable structural disease (valve, TAVI planning, or congenital AF ablation) Benign masses	In >8 weeks
Semi-urgent	Chronic AF cardioversion Chronic or subacute prosthetic valve dysfunction	In 4-8 weeks
Urgent	High-risk acute or stable chest pain Structural emergency interventions (such as TAVI, and left atrial occlusion) or acute AF cardioversion Acute heart failure of unknown cause Acute valve dysfunction (or prosthesis) Planning of biopsy of malignant mass Discard thrombi when CMR is not feasible	In a few hours or <2-4 weeks (depending on severity)

AF = atrial fibrillation; TAVI = transcatheter aortic valve implantation; CMR = cardiac magnetic resonance imaging.

such involvement are not yet clear, the aforementioned ESC document suggests that elevated troponin levels associated with myocardial dysfunction or severe arrhythmia not explained by other methods may be an indication for CMR if the diagnosis is crucial for the treatment and if the patient is stable enough to be safely transferred for examination.³ The current guidelines of the Society for Cardiovascular Magnetic Resonance (SCMR)⁷ suggest that a CMR should be carefully and individually considered in patients with suspected acute myocarditis where there are immediate consequences for patient management (Table 2).

Regarding security procedures, precautions for all imaging modalities are similar. Nurses, biomedical specialists, and technologists should always wear personal protective equipment, including gloves and face masks when preparing the patient. Patients should always wear masks throughout the preparation and scanning. Cleaning of devices, including EKG cables, coils, and electrodes, must be mandatory; it should be thoroughly performed immediately after the procedure. When possible, a dedicated scanner should be reserved for infected patients or those with high clinical suspicion as a strategy to reduce the risk of contamination.

Finally, we reiterate that some of our recommendations regarding the appropriate use of imaging modalities in the COVID-19 pandemic should be considered only as expert advice because of the lack of scientific evidence-based data. Our intention is only to foster public knowledge, scientific debate, and clinical surveillance of the new and challenging cardiovascular complications of COVID-19.

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Table 2 - Main clinical conditions that are considered “urgent” for the use of CMR in the context of COVID-19, according to the Society for Cardiovascular Magnetic Resonance (SCMR).

Clinical conditions	Suggested time for CMR
<ul style="list-style-type: none"> • Acute myocarditis with immediate patient management consequences. • Investigation of ischemia and myocardial viability to guide urgent revascularization. • Suspected intracardiac mass or thrombus with contraindicated anticoagulation, or patients with suspected embolic events. • Planning for urgent ablation in unstable patients with severe arrhythmias. • Pericardial constriction which may require urgent surgery. • Planning for percutaneous prosthetic heart valve implantation which may require urgent surgery. 	Within one week or less, depending on disease severity.

Note 1: Choices based on expert consensus. Note 2: Individual clinical conditions and contraindications to examination must be considered.

Conflict of interest

The authors have declared that they have no conflict of interest.

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