International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

A Review on Myocarditis and Cardiomyopathy

Md Ashif

Clinical Research Scholar, Teerthanker Mahaveer College of Pharmacy, Moradabad

Abstract

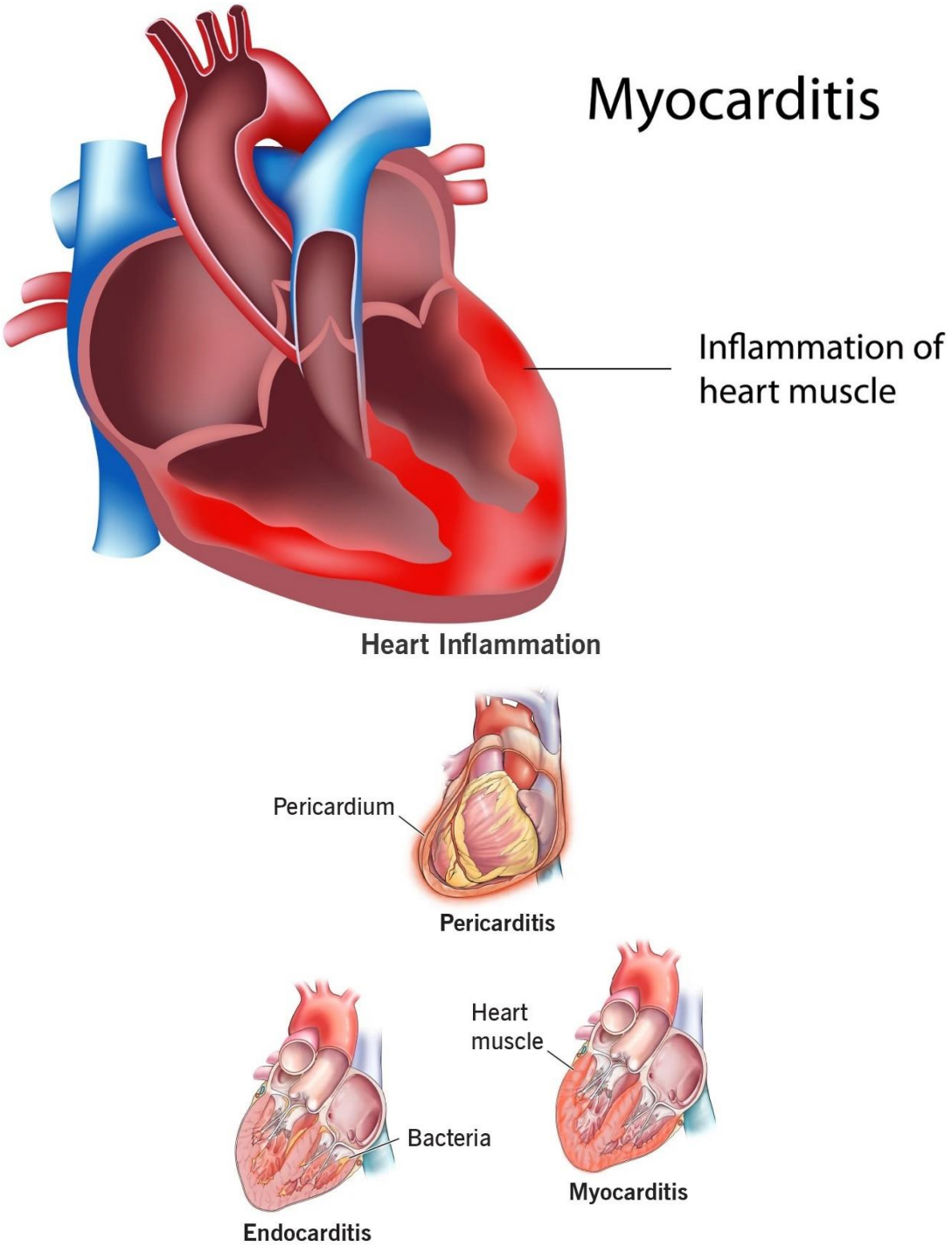
Myocarditis presents a complex challenge with diverse causes, including infectious agents and non-infectious factors. Despite advancements, it remains associated with poor prognosis, especially when complicated by heart dysfunction. This review discusses its pathogenesis, diagnosis, treatment, and prognosis, covering various infectious and non-infectious triggers. Diagnosis involves electrocardiography, imaging, and sometimes biopsy. Treatment focuses on managing heart failure and arrhythmias, with ongoing research
aiming to improve outcomes. Collaborative efforts are crucial for advancing understanding and care for this condition.

Keywords: Myocarditis, Inflammation, Myocardium, Etiology, Diagnosis

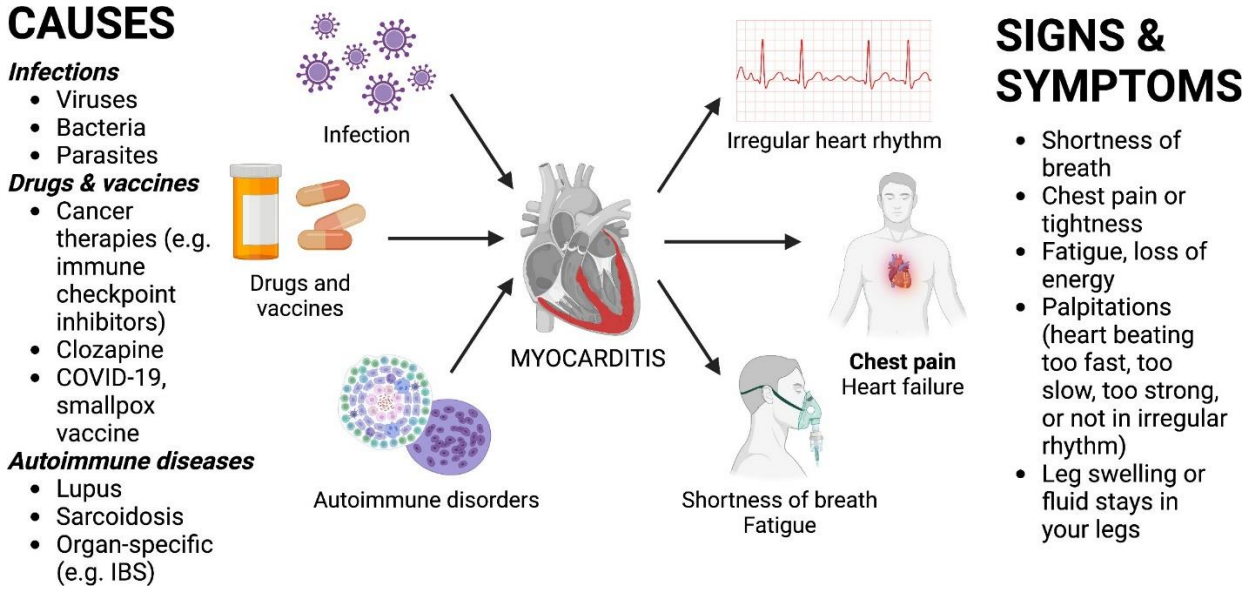
Introduction:

Myocarditis specify to inflammation in the region of myocardium and can be caused by infectious agents, systemic diseases, medications and poisons, with viral infections remaining the most common cause in the advance countries. It is also known as Inflammatory cardiomyopathy related with cardiac dysfunction and vascular remodelling.[1] The clinical symptoms related with myocarditis are highly variable and may range from angina, palpitations and heart failure to cardiogenic shock and death . Myocarditis may progress to a dilated cardiomyopathy (DCM) in nearly 30% of cases, and accounts for 9 – 16% of all non ischemic DCM among adult patients.Inspite of extensive research and improved diagnosis and understanding of the pathogenesis of inflammatory cardiomyopathy, this disorder is still related with a poor prognosis when complicated by left ventricular (LV) dysfunction, congestive heart failure (CHF) or arrhythmia.Furthermore, fulminant myocarditis, a rare, sudden and severe cardiac inflammation, is one of the main causes of cardiogenic shock in young adults.[2]

In this review article, we are going to discuss available evidence and identify the unidentified space in our understanding of the pathogenesis, diagnosis, treatment and prognosis of myocarditis and inflammatory cardiomyopathy.



Causes: Myocarditis may be caused by infections, some medications and chemicals, or a situation that causes body-wide inflammation. Often,the cause of myocarditis has not found yet.[3]



Potential causes of myocarditis include:

Viruses:A number of viruses have been linked to myocarditis, including those that cause the common cold (adenovirus); COVID-19; hepatitis B and C; parvovirus, which causes a mild rash, usually in children (fifth disease); and herpes simplex virus.

Some other viruses include gastrointestinal infections (echo viruses), one nucleosis (Epstein-Barr virus) and German measles (rubella) also can cause myocarditis. Sometime Myocarditis may also be caused by Human Immunodeficiency Virus, the virus that causes AIDS.[3]

Bacteria:Bacteria that can cause myocarditis involve staphylococcus, streptococcus, and those bacteria that can cause diphtheria and Lymedisease.[3]

Parasites:The parasites among these are Trypanosoma cruzi and toxoplasma. Some parasites may be transmitted by insects and can cause a condition called Chagas disease. Chagas disease is much more common in Central and South America than in the United States.[3]

Fungi:A fungal infection may cause myocarditis, particularly in people with very low immunity. These are linked to myocarditis including yeast infections, such as candida; molds, such as aspergillus; and histoplasma, often found in bird droppings.[3]

Myocarditis may also be caused by:

Certain medications or illegal drugs:These drugs are used to treat cancer; some antibiotics such as penicillin and sulfonamide drugs; some anti-seizure medications and cocaine.

Chemicals or radiation:Exposure to carbon monoxide(CO) and radiation can sometimes cause heart muscle inflammation.

Other inflammatory diseases:Conditions that may cause myocarditis include lupus, Wegener's granulomatosis, giant cell arteritis and Takayasu'sarteritis.

Complications:

Usually, myocarditis goes away without permanent complications. However, chronic myocarditis can be for all time damage the heart muscle.Potential complications of myocarditis may include:

Heart failure :Untreated, myocarditis can damage the heart muscles so that it can't pump blood easily. In chronic cases, myocarditis related heart failure may require a ventricular assist device or a heart

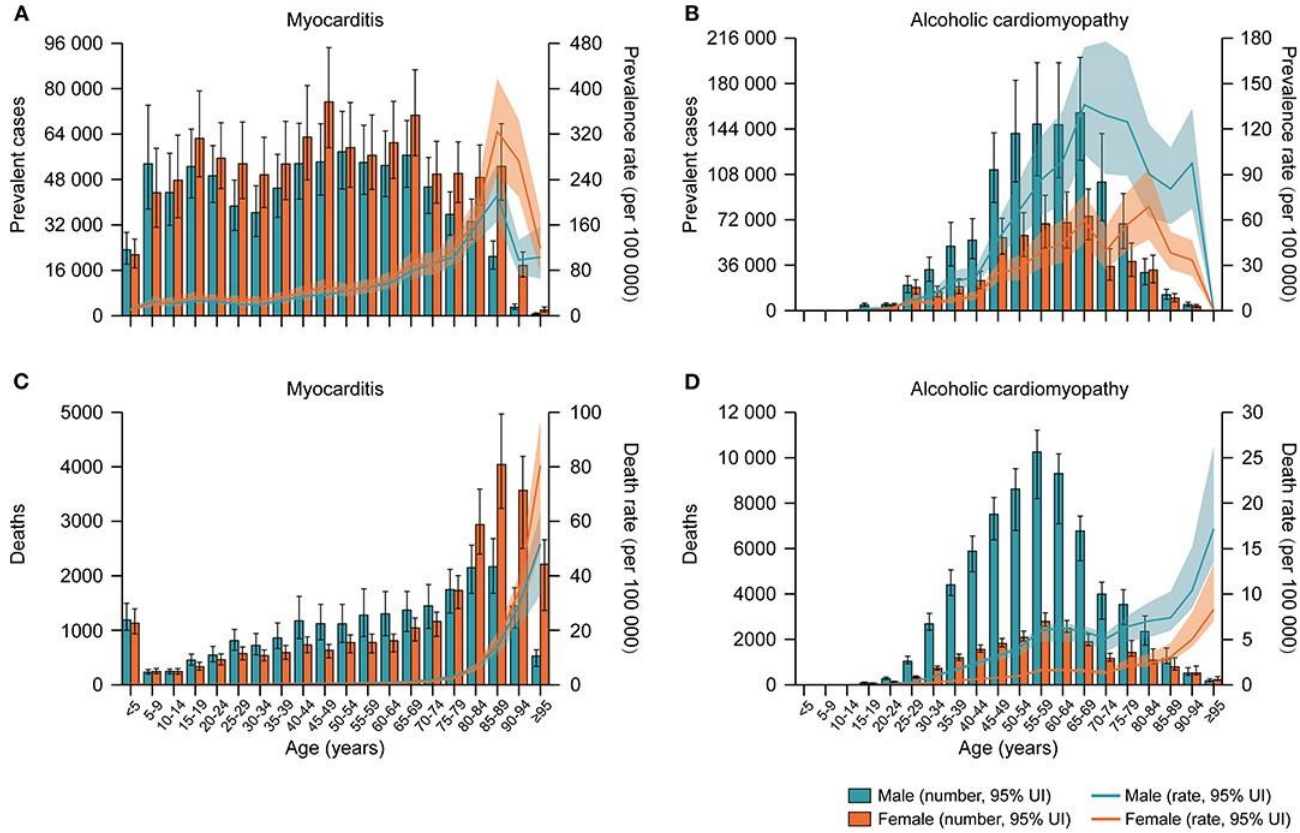
transplant.[4]

Heart attack or stroke: If the heart muscle is injured and can't pump blood, the blood that collects in the heart, can form thrombus plaque and blocks the blood to the heart which further cause damage due to low demand and supply of oxygen. A congestive heart failure can occur if a clot blocks one of the heart (coronary) arteries. A stroke can occur if a blood clot in the heart travels to an artery leading to the brain which can be seennormal in CT but not in MRI.[4]

Rapid or irregular heart rhythms (arrhythmias): Damage to the heart muscle can change how the heart beats. Such arrhythmias increase therisk of stroke.

Sudden cardiac death: Such serious arrhythmias can cause the heart to stop beating (sudden cardiac arrest). It can be deadly if not treatedimmediately (sudden cardiac death).

Epidemiology: Myocarditis may be result in heart failure in around 12– 17% of adults with a death rate of approximately 8.4 per 100 000. There are several variations but two variations are most common, regional and temporal variations in myocarditis with a noted increased death rates from 1980 to 1995 that then declined. Males are more often affected than females with the peaks in prevalence seen in children and young adults aged 20–30 years.[5]



Age-specific numbers and rates of prevalent cases and deaths for myocarditis and alcoholic cardiomyopathy by sex, 2017. (A) Age-specific numbers and rates of myocarditis prevalent cases; (B) Age-specific numbers and rates of alcoholic cardiomyopathy prevalent cases; (C) Age-specific numbers and rates of myocarditis deaths; (D) Age-specific numbers and rates of alcoholic cardiomyopathy deaths.

Pathophysiology of myocarditis:

Myocarditis is inflammation of myocardium with slowly death of cardiac myocyte cells.A test called

Biopsy-proven myocarditis typically demonstrates inflammatory infiltrate of the myocardium with lymphocytes, neutrophils, eosinophils, giant cells, granulomas, or a mixture.
The pathophysiology of myocarditis and cardiomyopathy remains a subject of research. Potential mechanisms that lead to myocardial injury include

Direct cardiomyocyte injury caused by an infectious or other cardiotoxic agent.
Myocardial injury caused by an autoimmune reaction to an infectious or other cardiotoxic agent.

Myocardial inflammation can be diffuse or focal. The inflammation in the region of myocardium can extend into the pericardium causing myopericarditis. The duration of myocardial involvement and extension into nearly located pericardium can determine the type of symptoms. The diffused involvement can lead to congestive heart failure, irregular heart rhythm and sometimes sudden cardiac death. Focal involvement is less likely to cause congestive heart failure but can lead to irregular heart rhythm and sudden cardiac death. Involvement of the the heart muscle pericardium leads to stable angina and other symptoms typical of pericarditis. Some patients remain asymptomatic whether myocardial involvement is focal or diffused.[6]
The most common viral causes are including parvovirus and Human Herpes Virus in high income areas and in low income areas the the myocarditis associated with the virus of AIDS and rheumatoid arthritis.Sometime infectious myocarditis caused by SARS Co-V-2 Infection with mild chest discomfort, the myocarditis is more than 16% common in infective patients than non infective patients.
Noninfectious causes include cardiotoxins, various drugs, and some blood related disorders. Myocarditis caused by some medications is termed hypersensitivity myocarditis. Myocarditis after mRNA-based COVID-19 vaccination is rare and far less common than COVID-associated myocarditis.It occurs mostly in adolescent and young adult males, usually within a week of vaccination, and is generally mild.
Giant cell myocarditis is an exceptional form of myocarditis with a fulminant course. The etiology is not clear yet but may include an autoimmune mechanism. A test called biopsy shows characteristic multinucleated giant cells. Patients with giant cell myocarditis present in cardiogenic shock and often have intractable ventricular irregular heart rhythm or complete heart block. Giant cell myocarditis has a less acceptable prognosis but is important to sign out in the setting of an otherwise healthy patient presenting in fulminant heart failure or with intractable irregular heart rhythm because immunosuppressive therapy can help improve survival.[7]

Signs and Symptoms:

Fulminant heart failure, the patient may feel symptoms including fatigue, dyspnea, and edema. Patients may show signs of fluid high retention with crackles, elevated jugular venous pulses, and edema. Cardiac tests may be significant for S3 and S4 heart sound.Atrial murmurs of mitral repeatition and tricuspid repeatition may be present in patients with ventricular enlargement.[8]
Fatal irregular cardiac rhythms, Sudden cardiac death chances are high in patients with fatal arrhythmias.

Diagnosis of Myocarditis:

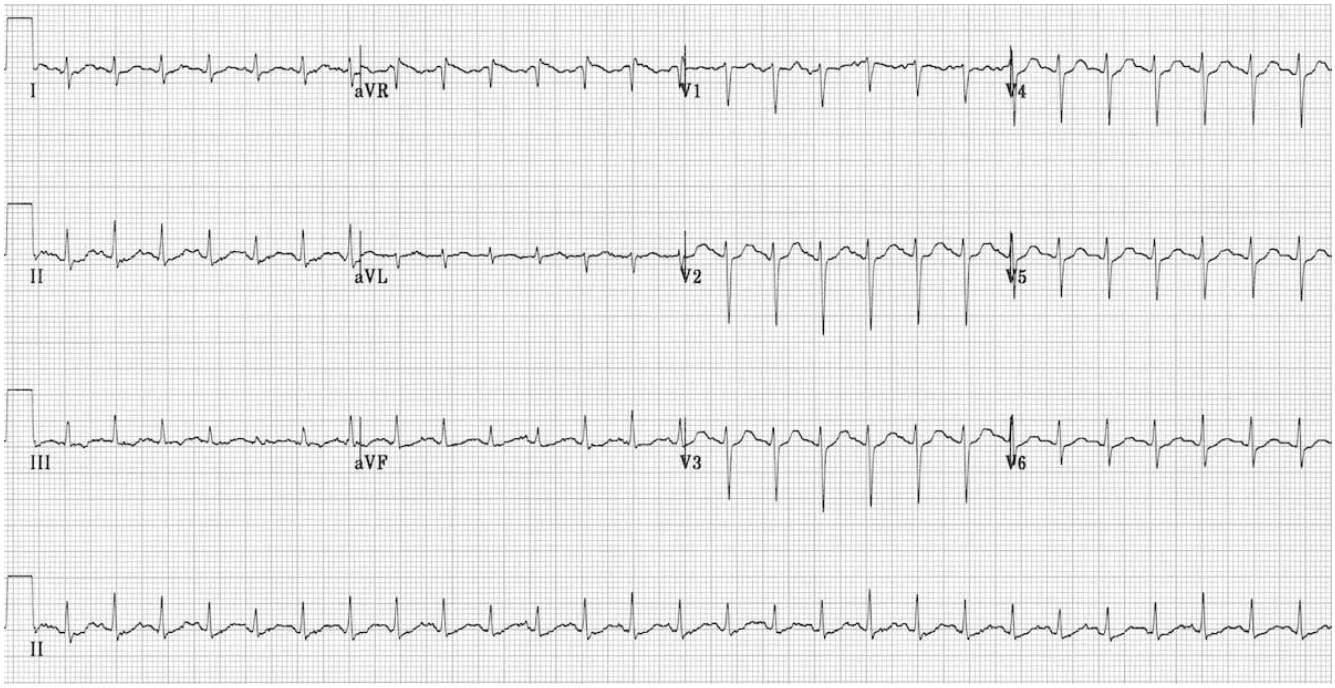
Electrocardiography (ECG) and cardiac enzymes
Cardiac imaging

Sometimes, endomyocardial biopsy
Tests to identify cause

ECG:ECG can be normal or abnormal in patients with myocarditis. ST segment disturbances are common and can impersonate myocardial ischemia. ST segment elevation is sometimes seen but more common findings include nonspecific ST-T wave changes. Patients may suffer from conduction delays and atrial or ventricular arrhythmias, including sinus tachycardia, ventricular tachycardia, and ventricular fibrillation. The QRS timing increases from 0.42 sec to elevate levels.

Cardiac enzymes can be abnormal in patients with acute myocarditis. Cardiac troponin and CK-MB (creatine kinase muscle band isoenzyme) canboth be elevated due to necrosis of cardiac myocytes.

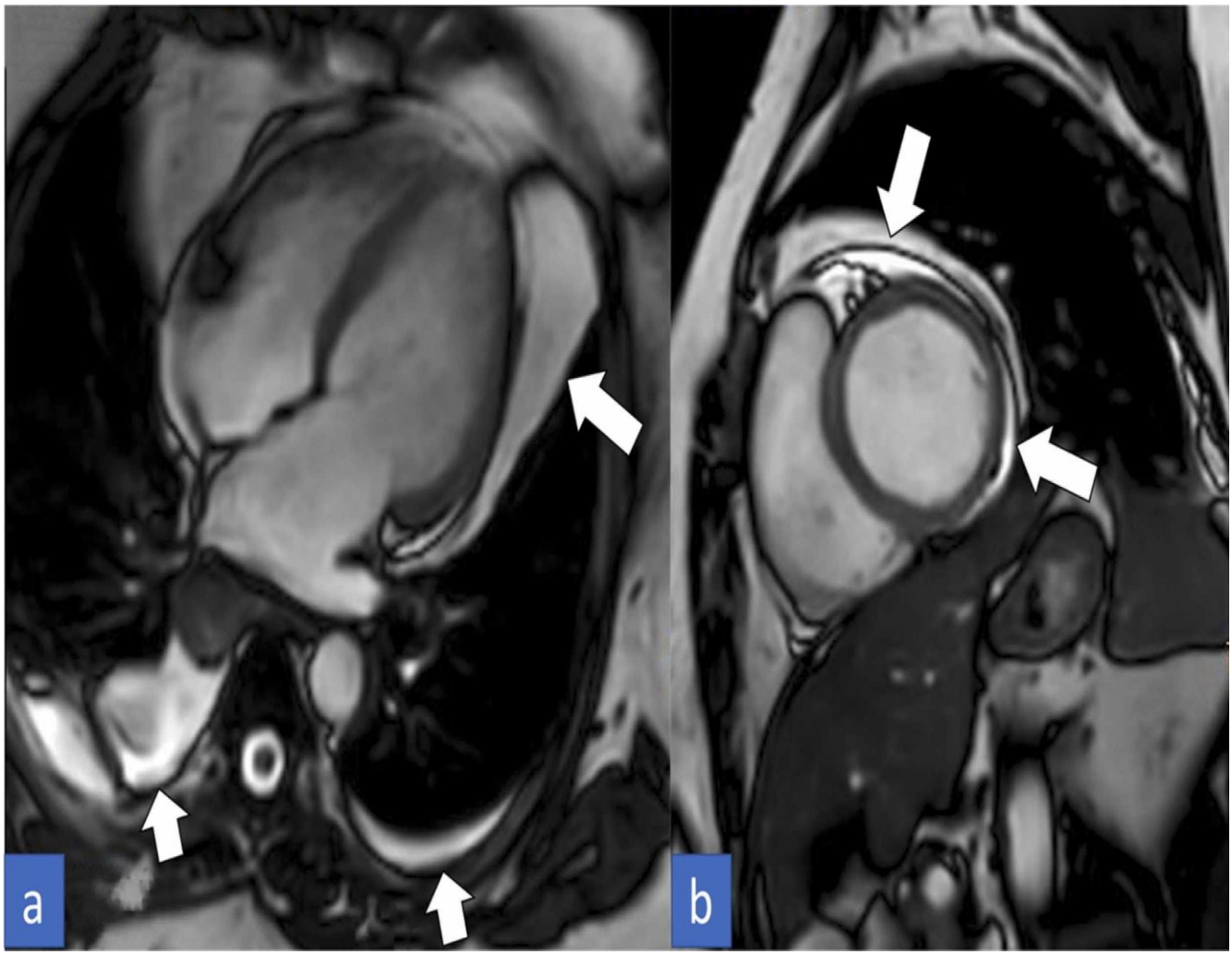
This ECG shows Sinus tachycardia with non-specific ST segment changes.[9]



Cardiac imaging: Cardiac imaging can be abnormal in patients with myocarditis. Echocardiogram can be normal in early or mild myocarditis, but segmental wall motion abnormalities (mimicking myocardial ischemia) can be seen. Left ventricular dilation and systolic dysfunction can also be seen as in dilated cardiomyopathy. Diastolic relaxation parameters are often abnormal on echocardiography. Cardiac MRI is becoming increasingly important in the diagnosis of myocarditis. Cardiac MRI of patients with myocarditis may show a characteristic pattern of late gadolinium enhancement in the subepicardial and mid-myocardial walls (in contrast to ischemia where late gadolinium enhancement is usually subendocardial with extension to mid-myocardial and epicardial walls). Other diagnostic features of myocarditis on cardiac MRI are the presence of myocardial edema and myocardial hyperemia relative to skeletal muscle.[10]

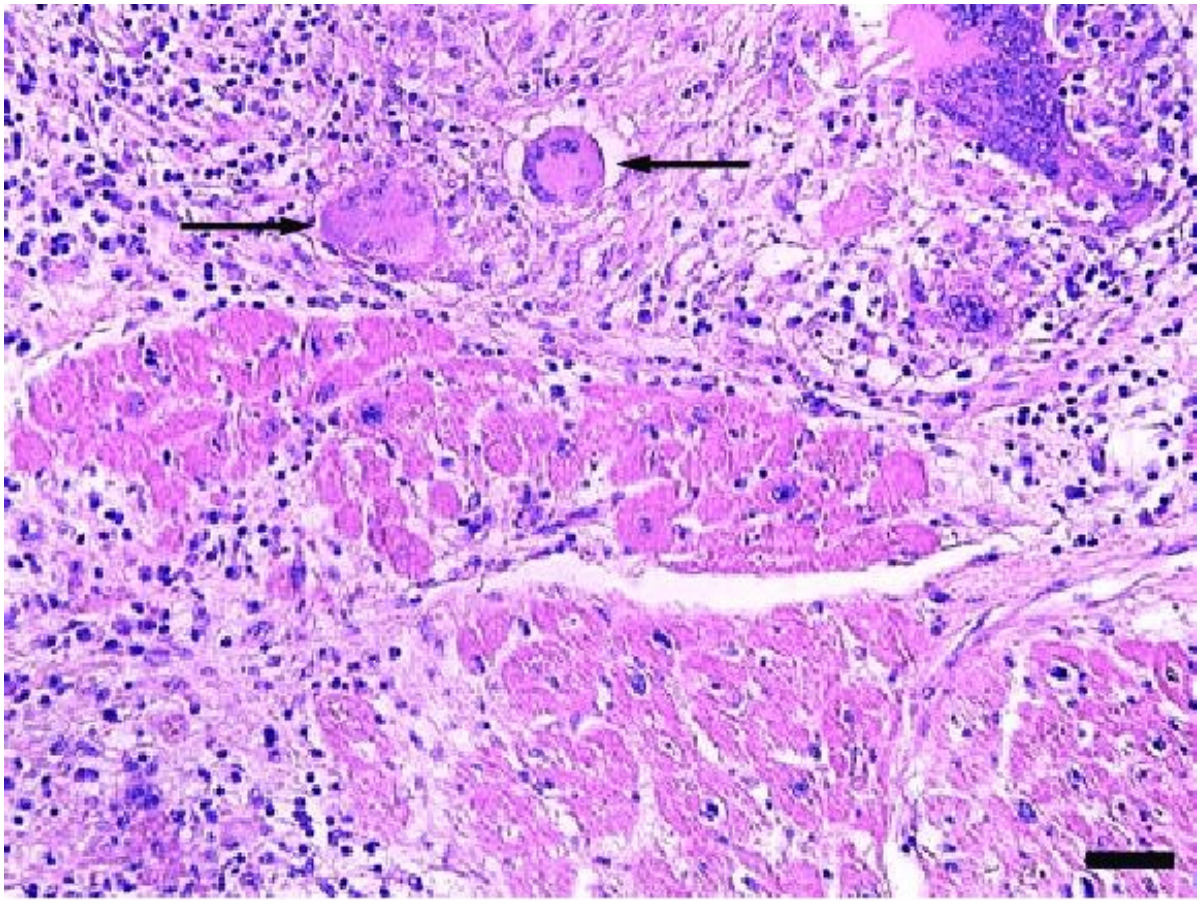
Cardiac Magnetic Resonance (CMR) T2 short-tau inversion recovery (STIR) (a) and post-contrast

delayed gadolinium-enhancement (DGE) image



short-axis view (b) showing high signal intensity in the myocardium with a subepicardial pattern of delayed GAD enhancement in the anterior andanteroseptal segments (arrow).

Endomyocardial biopsy:showing inflammatory infiltrate of the myocardium with necrosis of adjacent myocytes is the gold standard for diagnosis of myocarditis. However, this test has low sensitivity for diagnosis for myocarditis due to sampling error. Therefore, a positive biopsy result is diagnostic for myocarditis, but a negative result does not rule it out. In addition, the biopsy carries a risk of complications, including myocardial rupture and death, so is not routinely done. Endomyocardial biopsy should be done in cases of fulminant heart failure, ventricular arrhythmias, or heart block or if results would affect management (eg, if there is suspicion for giant cell myocarditis where prompt treatment can decrease mortality rates).[11]



Different kind of other tests are there to see complications

A complete blood count is useful to check wether the patient is suffering from eosinophilia, which is present in hypersensitivity myocarditis. Cardiac catheterization may be useful for ruling out ischemia since myocarditis can mimic myocardial infarction or myocardial ischemia.[11]

Treatment of Myocarditis:

Treatment of heart failure and arrhythmias
Treatment of underlying disorder

Patients who present with myocarditis with acute dilated cardiomyopathy should be treated according to the current guidelines of the American Heart Association, the American College of Cardiology, the European Society of Cardiology, and the Heart Failure Society of America.The main- stay of therapy for acute myocarditis is supportive therapy for left ventricular dysfunction. Most patients will improve with a standard heartfailure regimen that includes the administration of angiotensin converting enzyme inhibitors or angiotensin receptor blockers, beta-blockers such as metoprolol and carvedilol, and diuretics, if needed. In patients whose condition deteriorates despite optimal medical management, case series suggest a role for mechanical circulatory support, such as ventricular assist devices or extracorporeal membrane oxygenation, as a bridge to transplantation or recovery. The overall rate of survival after cardiac transplantation for myocarditis is similar to that for other causes of cardiac failure Treatment of heart failure includes diuretics(torcemide, amiloride, spironolactone etc) and nitrates(Glyceryl tri nitrate, Isosorbide di and mono nitrate, erythritol tetra nitrate) for symptomatic relief. In cases of fulminant heart

failure, intraaortic balloon pump (IABP), left ventricular assist device (LVAD), or transplantation may be necessary. Long-term drug treatment of heart failure involves angiotensin- converting enzyme (ACE) inhibitors(Enalpril, captopril), beta-blockers(propranolol, atenolol, metoprolol), aldosterone antagonists, angiotensin II receptor blockers (ARBs), or angiotensin receptor/neprilysin inhibitors (ARNIs). Atrial and ventricular arrhythmias are treated with antiarrhythmic therapy. Heart block can be treated with temporary pacing but may require insertion of permanent pacemaker if conduction abnormalities persist.[12]

Infectious myocarditis is generally treated with supportive therapy for associated heart failure and arrhythmias. Antiviral therapy has not been shown to be helpful in the treatment of most viral etiologies, but nirmatrelvir and ritonavir can help treat myocarditis due to SARS-CoV2 infection, and oseltamivir can help treat myocarditis due to influenza. Corticosteroids may also help treat myocarditis due to SARS-CoV2 infection. Bacterial etiologies may be treated with antibiotics, but this has not been shown to be effective except possibly in the acute infectious phase. Parasitic infection should be treated with appropriate antiparasitic drugs.[12]

Hypersensitivity myocarditis is treated by immediate discontinuation of the causative drug or cardiotoxin and, for hypersensitivity myocarditis, corticosteroid therapy. Patients with giant cell myocarditis have improved survival when treated with immunosuppressants, usually corticosteroids and cyclosporine. Myocarditis caused by sarcoidosis can be treated with corticosteroids.[13]

SUMMARY AND FUTURE DIRECTIONS:

In conclusion, this paper has explored the multifaceted aspects of myocarditis, a challenging and potentially life-threatening condition. We have delved into its etiology, pathogenesis, clinical manifestations, diagnostic modalities, and treatment options. Myocarditis represents a complex interplay of infectious, immune-mediated, and inflammatory processes, demanding a comprehensive approach to diagnosis and management. As our understanding of this condition continues to evolve, it is imperative that healthcare professionals remain vigilant in their efforts to identify and treat myocarditis promptly. Future research endeavors hold promise for refining diagnostic criteria, developing targeted therapies, and improving outcomes for patients afflicted by this enigmatic cardiac disorder. Ultimately, a collaborative effort among clinicians, researchers, and healthcare institutions is essential to advance our knowledge and enhance the care provided to individuals affected by myocarditis.

This review explores an approach to suspected myocarditis based on the likelihood of identifying a treatable underlying condition. An important question for the future is whether myocarditis diagnosis will still necessitate confirmation through tissue analysis. Cardiac MRI shows promise as a diagnostic tool but requires further validation for noninvasive diagnosis and prognosis in both acute and chronic cases of myocarditis. Looking ahead, the analysis of messenger RNA and protein markers from peripheral blood may offer the potential to detect significant inflammation in high- risk populations without the need for risky endomyocardial biopsy. Additionally, ongoing research is actively investigating the treatment of specific subgroups of myocarditis, including those associated with chronic viral infections and nonviral causes, with guidance from biopsy-driven therapies.

References:

1. Cooper L.T., Baughman K.L., Feldman A.M., Frustaci A., Jessup M., Kuhl U., Levine G.N., Narula J., Starling R.C., Towbin J. The role of endomyocardial biopsy in the management of cardiovascular

disease: A scientific statement from the American Heart Association, the American College of Cardiology, and the European Society of Cardiology Endorsed by the Heart Failure Society of America and the Heart Failure Association of the European Society of Cardiology. Eur. Heart J. 2007

2. Bozkurt B., Colvin M., Cook J., Cooper L.T., Deswal A., Fonarow G.C., Francis G.S., Lenihan D., Lewis E.F., McNamara D.M. Current diagnostic and treatment strategies for specific dilated cardiomyopathies: A scientific statement from the American Heart Association.
3. Friedrich M.G., Sechtem U., Schulz-Menger J., Holmvang G., Alakija P., Cooper L.T., White J.A., Abdel-Aty H., Gutberlet M., Prasad S. Cardiovascular magnetic resonance in myocarditis: A JACC White Paper. J. Am. Coll. Cardiol. 2009
4. Wilson NJ, Boniface K, Chan JR, et al. Development, cytokine profile and function of human interleukin 17-producing helper T cells.
5. Sheppard R, Bedi M, Kubota T, et al. Myocardial expression of fas and recovery of left ventricular function in patients with recent-onset cardiomyopathy. 6.Felker GM, Boehmer JP, Hruban RH, et al. Echocardiographic findings in fulminant and acute myocarditis.
6. Mendes LA, Picard MH, Dec GW, Hartz VL, Palacios IF, Davidoff R. Ventricular remodeling in active myocarditis: Myocarditis Treatment Trial. 8.Laissy JP, Messin B, Varenne O, et al. MRI of acute myocarditis: a comprehensive approach based on various imaging sequences.
7. Moloney ED, Egan JJ, Kelly P, Wood AE, Cooper LT., Jr Transplantation for myocarditis: a controversy revisited. J Heart Lung Transplant. 10.Tominaga M, Matsumori A, Okada I, Yamada T, Kawai C. Beta-blocker treatment of dilated cardiomyopathy: beneficial effect of carteolol in mice.
8. Barton M, Finkelstein Y, Opavsky M, et al. Eosinophilic myocarditis temporally associated with conjugate meningococcal C and hepatitis B vaccines in children. 12.Cooper LT, Zehr KJ. Biventricular assist device placement and immunosuppression as therapy for necrotizing eosinophilic myocarditis.
9. Kilgallen CM, Jackson E, Bankoff M, Salomon RN, Surks HK. A case of giant cell myocarditis and malignant thymoma: a postmortem diagnosis by needle biopsy.