

# Chapter 71

## Approach to Myocarditis in the ICU



### 71.1 Introduction

Myocarditis is an inflammatory disease of the myocardium that poses significant diagnostic and therapeutic challenges in the intensive care unit (ICU). Its clinical presentation can mimic other cardiac conditions, such as acute coronary syndromes, making timely and accurate diagnosis crucial. Advances in diagnostic criteria, imaging modalities, and understanding of its diverse etiologies have improved patient management [1] [Ref: Algorithm 71.1].

### 71.2 Diagnostic Approach

#### 71.2.1 Enhanced Diagnostic Criteria

Accurate diagnosis of myocarditis requires a combination of clinical suspicion and advanced diagnostic tools. The Lake Louise Criteria, established for cardiac magnetic resonance imaging (CMR), serve as a standardized approach to differentiate myocarditis from other cardiac conditions. These criteria focus on the detection of myocardial edema, hyperemia, and necrosis or fibrosis through specific CMR sequences.

In complex cases where CMR findings are inconclusive, combining CMR with endomyocardial biopsy (EMB) enhances diagnostic accuracy. EMB allows for histological examination and immunohistochemical analysis, providing definitive evidence of myocarditis and aiding in identifying specific etiologies.

### 71.2.2 Advanced Imaging Modalities

Beyond CMR, positron emission tomography (PET) imaging has emerged as a valuable tool in detecting myocardial inflammation. PET imaging, especially when combined with CMR, improves diagnostic sensitivity and specificity. Additionally, emerging biomarkers such as microRNAs are being investigated for their potential to provide noninvasive diagnostic information and to monitor disease progression [2].

## 71.3 Etiological Classification

Understanding the underlying cause of myocarditis is essential for targeted therapy. The etiologies of myocarditis are diverse and include:

- Viral Myocarditis
  - Viruses are the most common cause of myocarditis. Common viral agents include Coxsackievirus B, Parvovirus B19, Adenovirus, and Human Herpesvirus 6. Molecular techniques like polymerase chain reaction (PCR) on EMB samples can detect viral genomes, guiding antiviral therapy.
- Autoimmune Myocarditis
  - Autoimmune processes can lead to myocarditis either as a primary cardiac manifestation or secondary to systemic autoimmune diseases such as systemic lupus erythematosus or sarcoidosis. Identification of autoimmune etiology is critical, as it alters the management approach towards immunosuppressive therapy.
- Drug-Induced and Hypersensitivity Myocarditis
  - Certain medications and hypersensitivity reactions can induce myocarditis. Offending agents include some antibiotics, antiepileptics, and chemotherapeutic agents. Early recognition and discontinuation of the causative drug are vital.
- Rare Causes
  - Immune Checkpoint Inhibitor-Associated Myocarditis: With the increasing use of immune checkpoint inhibitors in oncology, myocarditis has emerged as a rare but severe adverse effect. Early detection is essential due to its high mortality rate.
  - Genetic Predispositions: Genetic mutations affecting cardiac proteins can predispose individuals to myocarditis. Understanding genetic factors may guide future personalized therapies [3].

## 71.4 Clinical Presentations

Myocarditis presents with a spectrum of clinical manifestations:

### 1. Arrhythmias and Conduction Abnormalities

- Patients may develop arrhythmias ranging from premature ventricular contractions to life-threatening ventricular tachyarrhythmias. Conduction abnormalities, including atrioventricular block, are also common.

### 2. Fulminant Cardiogenic Shock

- Fulminant myocarditis is characterized by sudden and severe heart failure leading to cardiogenic shock. It requires immediate recognition and aggressive management in the ICU..

### 3. Pediatric Considerations

- Pediatric myocarditis often presents differently from adults, with infants and children exhibiting symptoms such as irritability, poor feeding, and respiratory distress. Management strategies may differ due to variations in etiology and disease progression in the pediatric population.

## 71.5 Management Strategies

### 71.5.1 *Risk Stratification and Personalized Treatment*

Management of myocarditis is tailored based on the severity of the presentation:

#### Stable Patients

- Supportive Care: Includes monitoring for arrhythmias, managing heart failure symptoms, and restricting physical activity to reduce cardiac stress.
- Medical Therapy: Standard heart failure medications such as ACE inhibitors, beta-blockers, and diuretics may be used cautiously.

#### Fulminant Myocarditis

- Hemodynamic Support: Inotropes may be necessary to support cardiac output.
- Mechanical Circulatory Support: Devices such as intra-aortic balloon pumps, ventricular assist devices, or extracorporeal membrane oxygenation (ECMO) may be life-saving.
- Immunosuppressive Therapy: Early initiation may be considered, especially in autoimmune etiologies.

## Specific Therapies

- Immunosuppressive Therapy: Indicated for autoimmune myocarditis. Corticosteroids and other immunosuppressive agents can reduce myocardial inflammation.
- Antiviral Therapy: While the role of antiviral therapy remains limited, it may be considered in cases with confirmed viral etiology, particularly with replicating viruses.

### ***71.5.2 Integration of Immunophenotyping***

Emerging techniques like immunophenotyping of EMB samples help identify specific inflammatory pathways involved in myocarditis. This approach allows for the development of targeted therapies, potentially improving outcomes by addressing the underlying immunological mechanisms.

### ***71.5.3 Prognostic Markers***

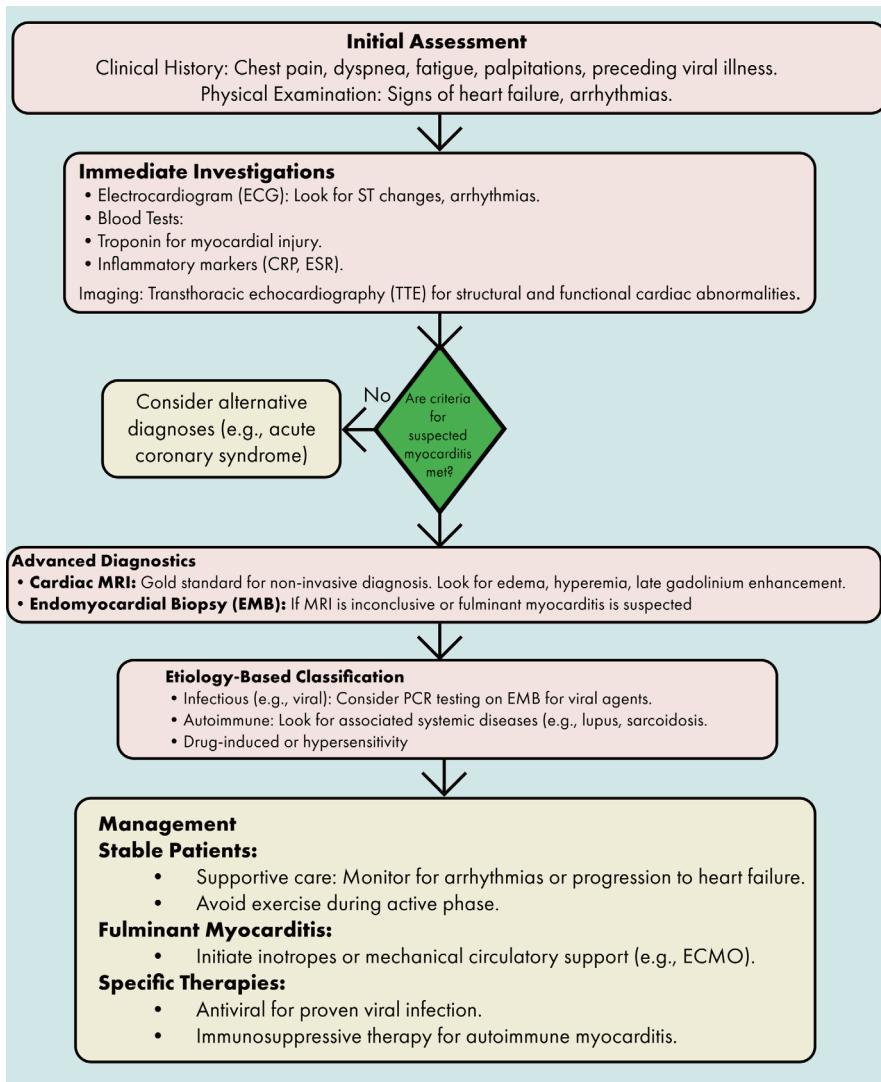
Biomarkers play a significant role in assessing prognosis:

- Tropionins: Elevated levels indicate myocardial injury and are associated with worse outcomes.
- N-terminal pro-B-type Natriuretic Peptide (NT-proBNP): Elevated levels reflect ventricular dysfunction and correlate with disease severity and prognosis.

## **71.6 Conclusion**

Myocarditis in the ICU demands a comprehensive and nuanced approach, integrating advanced diagnostic criteria, understanding of diverse etiologies, and personalized management strategies. Incorporating standardized criteria like the Lake Louise Criteria and utilizing advanced imaging modalities enhance diagnostic accuracy. Recognizing rare causes and pediatric differences ensures that all patient populations receive appropriate care. Risk stratification and the integration of immunophenotyping pave the way for targeted therapies, improving patient outcomes. Through this systematic approach, ICU clinicians can effectively navigate the complexities of myocarditis, providing optimal care for this challenging condition.

### Algorithm 71.1: Approach to myocarditis in the ICU



### Bibliography

1. Nagai T, Inomata T, Kohno T, Sato T, Tada A, Kubo T, et al. JCS 2023 guideline on the diagnosis and treatment of myocarditis. Circ J. 2023;87(5):674–754.
2. Chabior A, Tyminska A, Pawlak A, Giordani A, Caforio A, Grabowski M, et al. Advances in myocarditis management in the light of the latest research and recent guidelines of the European Society of Cardiology. Cardiol J. 2024;31(2):342–51.
3. Lampejo T, Durkin SM, Bhatt N, Guttman O. Acute myocarditis: aetiology, diagnosis and management. Clin Med (Lond). 2021;21(5):e505–e10.