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REVIEW ARTICLE

# Evaluation, management, and treatment of acute pericarditis and myocarditis in the emergency department

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Acute pericarditis is often found in association with acute myocarditis, mainly because viral infection is the most common cause of both. However, the different prognostic implications and specific risk of complications of each entity obliges us to distinguish between them whenever possible. The evaluation and management of an emergency department patient suspected of having acute pericarditis or myocarditis must rest on 4 pillars: clinical presentation, electrocardiography, biomarkers of heart disease, and transthoracic echocardiography. These initial assessments will indicate the level of risk of complications and guide the decisions of whether to admit the patient or not and start specific treatment. This review provides an up-to-date discussion of the main diagnostic and therapeutic considerations in acute pericarditis and myocarditis. [Emergencias 2010;22:301-306]

**Key words:** Pericarditis. Myocarditis. Emergency health services.

Acute myocarditis and pericarditis are two entities that should be diagnosed at an early stage in the emergency department (ED). However, the coexistence of common causative agents[1], a high rate of association[2] and similar symptoms in some cases mean that differential diagnosis between the two can be difficult. In addition, their different prognoses, risk of specific complications, need for hospitalization and treatment implications require a thorough knowledge of these two processes from the moment of patient consultation in the ED. This article reviews, from a practical standpoint, the recommended assessment, management and treatment of an ED patient with suspected myocarditis or pericarditis.

## Incidence

The incidence of acute pericarditis is estimated to be about 5% in patients admitted to the ED for chest pain of coronary origin[3]. The association with myocarditis or myopericarditis approximates 15% of all diagnosed cases of acute pericarditis[2]. The coexistence of common etiologies, mostly a virus[1], probably explains this association.

The actual incidence of myocarditis is unknown because most cases are completely asymptomatic on presentation[4]. Many cases are diagnosed as dilated cardiomyopathy in patients who have had subacute symptoms during months[4].

## Diagnostic criteria

The diagnosis of pericarditis, myocarditis or acute myopericarditis can be difficult. However, there are a number of criteria that help to make the diagnosis in the ED.

### *Diagnosis of acute pericarditis*

At least two of the following criteria must be met:

1. Typical chest pain associated with pericarditis.

2. Pericardial friction rub on auscultation.

3. Gradual changes in the electrocardiogram (ECG) such as diffuse ST elevation.

4. New or increased pericardial effusion.

*Diagnosis of myopericarditis*

Meeting criteria 1, 2 and 3 is suggestive of myopericarditis, and meeting all 4 criteria means the diagnosis is probable. Confirmation requires pathological diagnosis confirmed by endomyocardial biopsy, or autopsy.

1. Diagnosis of acute pericarditis.

2. Suggestive symptoms (dyspnea, palpitations or chest pain) and emerging electrocardiographic changes (tachycardia, atrioventricular block, extrasystoles or alteration of ST/T wave) or left ventricular dysfunction, focal or diffuse, of unknown origin.

3. No other causative agent.

4. One of the following:

a. Elevated cardiac biomarkers (CKMB, Troponin I or T).

b. Left ventricular dysfunction, focal or diffuse, of recent appearance.

c. Imaging test compatible with the diagnosis of myocarditis (MRI with gadolinium, gallium-67 scan or antimyosin antibody).

Fulminant myocarditis is defined to be an acute myocarditis presenting as acute cardiogenic shock requiring rapid onset of action of mechanical support and/or medication.

## Etiology

Viral infections are responsible for most cases[1], although there are many other causes (Table 1). The profile of the causative viral agents has changed over time. Between 1950 and 1990, coxsackievirus B was most frequently detected; at the end of last century, adenovirus was added and finally parvovirus B19 has been widely detected[5]. Nevertheless, myopericarditis has been associated with many other viruses such as Epstein-Barr virus, cytomegalovirus, humanherpesvirus 6, echovirus and hepatitis C virus, which is associated with acute myocarditis and dilated cardiomyopathy[6].

## Clinical symptoms

In acute pericarditis, the most common symptom is the appearance of sharp chest pain. Although usually of gradual onset, this pain can be confused with pain of coronary origin, prompting the patient to consult a medical emergency service in many cases. The pain typically radiates to the trapezoidal and scapular area, increases with inspiration, coughing or recumbency and generally eases on getting up, leaning forward, or sitting up on the stretcher. The onset of fever, fatigue, myalgia and previous common cold symptoms may help the differential diagnosis, but these only appear in 21% of pericarditis cases[2].

In myocarditis, chest pain only occurs in 35% of cases. Often, this chest pain is difficult to distinguish from a coronary pain, especially if accompanied by ECG changes and elevated cardiac biomarkers. Thus, some of these patients undergo coronary angiography which proves normal. Up to 78% of patients urgently catheterized for chest pain with normal coronary arteries present focal or diffuse signs of myocarditis on imaging tests[7]. In addition to chest pain, myocarditis may also be associated with a host of other symptoms, which often stem from a greater or lesser degree of heart failure (fatigue, dyspnea, orthopnea or paroxysmal nocturnal dyspnea). The palpitations secondary to arrhythmias may also be a reason for consultation

**Table 1.** Etiologic agents responsible for pericarditis and/or acute myocarditis

| |
|---|
| **1. Infectious agents** |
| 1.1. Viruses: Adenovirus, Arbovirus, Arenavirus, Coxsackie, Epstein-Barr virus, Cytomegalovirus, Echovirus, Encephalomyocarditis, Hepatitis B, Herpes virus 6, Human immunodeficiency virus-1, Influenza B, Rubella, Parvovirus B19, Poliomelitus,RespiratorySyncytial virus. |
| 1.2. Bacteria: Brucellosis, *Clostridium,* Diphtheria, *Francisela,* Gonococci, *Haemophilus, Legionella,* Meningococcus, Mycobacterium. *Mycoplasma,* Pneumococcus, Psittacosis, *Salmonella, Staphylococcus, Streptococcus,* Whipple disease, Rickettsis, Q Fever, Typhus, *Borrelia, Leptospira,* Syphilis. |
| 1.3. Fungi: *Actinomyces, Aspergillus, Blastomyces, Candida Coccidioides, Cryptococcus,* Histoplasma, Nocardia, *Sporothrix.* |
| 1.4. Parasites: *Cysticercus, Echinococcus, Schistosoma, Toxocara, Trichinela, Entamoeba, Leishmania, Trypanosoma,* Toxoplasma. |
| **2. Non-infectious agents** |
| 2.1. Autoimmune: |
| – Post-Injury pericardial / myocardial:acute myocardial infarction, post-pericardiectomy, post-traumatic. |
| – Autoimmune diseases: lupus erythematosus, rheumatoid arthritis, Sjögren syndrome, systemic sclerosis,vasculitis, Behçet syndrome, Mediterranean fever. |
| – Self-reactive pericarditis. |
| 2.2. Neoplastic: |
| – Primary tumors: Mesothelioma. |
| – Metastasis: the most common tumors are breast, lung and lymphoma. |
| 2.3. Metabolic: uremia, myxedema. |
| 2.4. Traumatic: |
| – Direct: Esophageal perforation, penetrating trauma. |
| – Indirect: blunt trauma, post-radiotherapy. |
| 2.5. Pharmaceutical agents-Drug: methyldopa, cocaine, sulfonamides, anthracyclines. |

and a history of fever or flu-like syndrome before admission occurs in 50% of miocarditis[2].

## Physical examination

Pericardial friction rub on auscultation is the most important manifestation of acute pericarditis. It appears in 33-85% of cases and is considered a pathognomonic finding[8-10]. The presence of pericardial friction rub confirms the diagnosis but its absence does not rule out the diagnosis.

In myocarditis, the majority of patients have a normal physical examination. However, if associated with ventricular dysfunction, there may be signs secondary to heart failure such as tachycardia, rales, jugular venous distension, etc. Hypotension at admission is rare, but is a sign of poor prognosis usually associated with severe ventricular dysfunction.

## Electrocardiagram

Electrocardiographic changes of acute pericarditis are common and typically have four stages that occur in up to 60% of patients[11].

– Phase I: The first finding is decreased diffuse PR segment, mainly in V5 and V6, followed by diffuse concave ST elevation. This occurs in the first hours and days. ST elevation is more common when associated with myocarditis (up to 90% of cases).

– Phase II: Normalization of PR and ST segments.

– Phase III: diffuse negative T wave.

– Phase IV: Normalization of ECG or persistence of negative T waves.

In myocarditis, the sensitivity of ECG is low (47%)[12], and the association with atypical changes is fairly frequent (40%). Among the most relevant changes are focal elevation of ST, and inversion of the T wave before ST elevation. The existence of Q waves or left bundle branch block is associated with a high rate of death or heart transplantation[13].

The occurrence of cardiac arrhythmias (often supraventricular or ventricular extrasystoles, but no sustained ventricular tachycardia in more aggressive cases) is more common in myocarditis (60%) than in acute pericarditis (10%).

## Cardiac Biomarkers

Increased values of troponin I and creatine kinase MB fraction (CK-MB) are the most relevant findings. Troponin I is a more sensitive biomarker of myocardial damage than CK-MB[14]. Elevation of these biomarkers occurs in 32%[15] in unselected patients with acute pericarditis, but increases to 70%[16] in hospitalized patients. Troponin I elevation is transient, with normal levels appearing between 7 and 10 days after presentation.

In myocarditis, troponin I shows high specificity (89%) but low sensitivity (34%)[14]. Thus it may be normal in 44-66% of cases, but if elevated can help confirm the diagnosis.

Elevated troponin I has been directly linked with the extent of inflammation, but does not seem to relate to worse prognosis. In contrast, low levels of troponin I have been associated with worse prognosis in the case of admission for severe myocarditis, probably due to subacute presentation[17].

## Echocardiogram

Echocardiographic examination is not essential to establish the diagnosis, but is a useful tool for identifying and/or quantifying the existence of pericardial effusion, cardiac tamponade or ventricular function.

The most frequent echocardiographic finding is pericardial effusion, especially in the case of acute pericarditis, which appears in approximately 60% of cases[18]. Pericardial effusion is classified into 3 groups according to diastolic distance between the pericardium and the ventricle[19]: 1) slight effusion of less than 10 mm; 2) moderate effusion of 10-20 mm, 3) severe effusion of more than 20 mm. The incidence of cardiac tamponade secondary to severe pericardial effusion is about 3%.

Transthoracic echocardiogram is helpful, especially if ventricular dysfunction is suspected after physical examination. Knowledge of ventricular function allows the introduction of treatment at an early stage and even appropriate supportive measures mechanical, like a balloon aortic or ventricular assistance. Right ventricular dysfunction seems to be the greatest predictor of mortality and cardiac transplantation[20].

## Other tests

Cardiac magnetic resonance imaging (CMRI) with gadolinium contrast probably offers the best balance between sensitivity (85%) and specificity (95%)[21]. In addition, CMRI allows identifying whether myocarditis is focal or diffuse and thus leads

to an endomyocardial biopsy which increases diagnostic sensitivity. The changes observed in CMRI may persist for as long as a month after the onset of symptoms.

Endomyocardial biopsy has high specificity (90-100%) but low sensitivity (38%) due to the collection of unaffected myocardial samples. There are only two situations where biopsy is considered as indication I by the European Society of Cardiology[22], when there is a suspicion of new onset fulminant myocarditis or giant cell myocarditis.

## Emergency Management and treatment

The diagnosis of acute pericarditis or myocarditis should be based on three fundamental pillars: clinical features (symptoms and physical examination), the ECG, and cardiac biomarkers (troponin and/or CKMB). Depending on the suspected diagnosis, one should follow the algorithm shown in Figure 1, where the identification of prognostic factors is associated with pericarditis[18] (Table 2) and transthoracic echocardiography should help focus the ED assessment. In the case of acute pericarditis, the identification of these factors associated with poor prognosis are of vital importance, because it can predict the risk of complications or the likelihood of associated processes[18]. In the absence of any such factors, the risk of complications is low and therefore outpatient treatment with anti-inflammatory agents is a safe strategy. In contrast, the presence of at least one of these factors indicates high risk and, therefore, should lead to hospital admission for monitoring, etiological study and specific treatment if necessary. Suspected myocarditis that is isolated or associated with one of the factors poor prognosis should lead to admission and monitoring for potential risks of ventricular and cardiac arrhythmia.

**Table 2.** Prognostic factors in acute pericarditis

1. Fever above 38ºC.
2. Subacute onset.
3. Immunosuppression.
4. Anticoagulation treatment.
5. Caused by trauma.
6. Myopericarditis.
7. Severe pericardial effusion.
8. Cardiac tamponade.
9. No anti-inflammatory response after 1 week.

Treatment with aspirin or other NSAID anti-inflammatory drugs is the treatment of choice for acute pericarditis. The initial dose of aspirin should be 500-1,000 mg every 6 hours, maintained while pain and fever persist. The dose may be reduced as the symptoms decrease, for example to 500 mg every 8 hours for 1 week, 250 mg

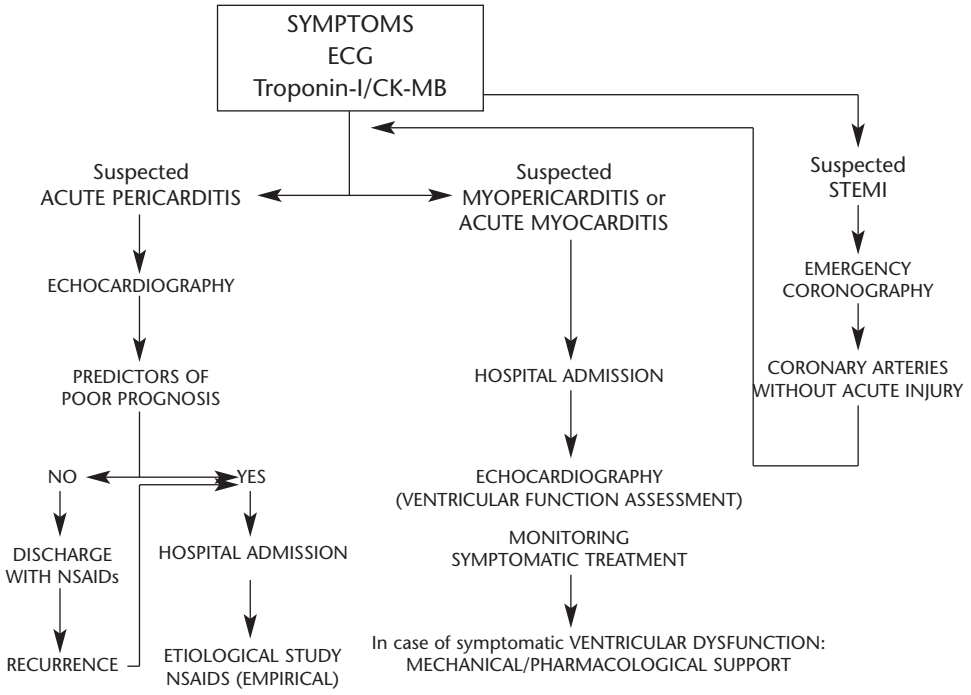


**Figure 1.** See Table 2. STEMI: acute myocardial infarction with ST elevation.NSAIDs: nonsteroidal antiinflammatory drugs. CK-MB: creatine kinase MB fraction.

every 8 or 12 hours for 2 weeks. If the patient does not respond or if aspirin is contraindicated, other NSAIDs may be used, such as indomethacin 75-225 mg/day or ibuprofen 1600-3200 mg/day. The inclusion of paracetamol or diclofenac to standard treatment may be a useful additional measure for the specific control of symptoms. All cases should receive gastric protection and relative rest, in bed or seated, while symptoms persist.

Treatment with colchicine is a valid alternative in case of recurrence, as this is the only drug that has been shown to reduce recurrence rate. The recommended dose is 2 mg daily for 2 days, followed 0.5 mg every 12 hours as maintenance dose.

Corticosteroids should be the last line of treatment because they are independently associated with recurrence. However, when deemed necessary, they should be used at high doses (1-1.5 mg/kg) for 1 month, with subsequent tapering and initiation of NSAIDs before the end of treatment[23].

In myocarditis, non-NSAID therapy appears to be ineffective and has even been shown to increase mortality associated with myocardial damage[24]. Thus low-dose NSAID therapy is only recommended for symptom control. Signs of heart failure or hypotension associated to severe ventricular dysfunction should prompt the use of mechanical (intra-aortic balloon or circulatory support) or pharmacological support measures. If the patient presents hemodynamic tolerance, angiotensin converting enzyme inhibitors or beta-blockers should be administered early. Finally, patient monitoring should not be forgotten because of the potential risk of arrhythmia.

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## Evaluación, manejo y tratamiento de las pericarditis y miocarditis agudas en urgencias

**Freixa X**

Las pericarditis y las miocarditis agudas son enfermedades que en muchos casos se asocian. La coexistencia de agentes etiológicos comunes, virus en su mayoría, son la principal causa de esta asociación. No obstante, las diferentes implicaciones pronósticas y el riesgo de complicaciones específicas a cada proceso, nos deben obligar a intentar diferenciar entre ambas siempre que sea posible. La evaluación y manejo del paciente que consulta en un servicio de urgencias con sospecha de pericarditis y/o miocarditis aguda se deben basar en cuatro pilares fundamentales: clínica, electrocardiograma, biomarcadores cardiacos y ecocardiografía transtorácica. Esta valoración inicial permite estratificar el riesgo potencial de complicaciones, la necesidad de ingreso hospitalario y la instauración de tratamiento específico. Este artículo revisa las principales consideraciones diagnósticas y terapéuticas actuales de la pericarditis y la miocarditis aguda. [Emergencias 2010;22:301-306]

**Palabras clave:** Pericarditis. Miocarditis. Urgencias.