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# Diagnosis and Management of Pericardial Effusions

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Pericardial effusions are a relatively common phenomenon, largely in part due to its many possible etiologies. Although a considerable amount of cases are idiopathic, careful history and physical examination will reveal the etiology in a vast majority of patients. The most effective tools, echocardiography and right heart catheterization, should be aimed not only at the diagnosis of the pericardial effusion, but also to the assessment of the severity of the pericardial effusion, since this will determine that individual patient's management. A small, asymptomatic pleural effusion of known etiology can be treated conservatively, mostly by treating the underlying cause and with careful observation for signs or symptoms of

deterioration. Large effusions can be treated with closed pericardiocentesis after routine evaluation for possible etiologies. For patients presenting actual or impending tamponade, the definitive treatment is either closed or open pericardiocentesis, depending on fluid accumulation characteristics, and it should not be delayed for the administration of medical treatment (inotropes, intravenous fluids). Routine evaluation of pericardial fluid is warranted in those cases in which a clear etiology was not established prior to pericardiocentesis.

*Key words: pericardial effusion, cardiac tamponade, pericardiocentesis, diagnosis, management*

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**A** pericardial effusion, or accumulation of fluid in the pericardial space, is a relatively common phenomenon. Most of the time, it is an incidental and silent finding secondary to a variety of systemic illnesses. However, it can also be viewed as a prognostic tool, as in intrathoracic neoplasms, as a diagnostic tool in myopericarditis and acute pericarditis, or both, as is the case of dissecting aortic aneurysm. Furthermore, it should be promptly diagnosed, as it may progress to cardiac tamponade. In this article we will present an overview of the etiology, clinical presentation, diagnosis, and management of pericardial effusions.

## Etiology

Pericardial effusions can occur as a result of almost any pericardial disorder, but the majority of them are due to the following causes<sup>1</sup>:

- Acute idiopathic or viral pericarditis
- Purulent pericarditis
- Tuberculous pericarditis
- Postmyocardial infarction or cardiac surgery

- Recent or remote sharp or blunt chest trauma
- Postcardiac diagnostic or interventional procedure ( permanent pacemaker implantation or cardiac catheterization)
- HIV infection
- Malignancy
- Recent or remote mediastinal radiation
- Collagen vascular diseases
- Dialysis or chronic renal failure
- Hypothyroidism
- Drugs (procainamide, isoniazid, hydralazine)

In addition, pericardial effusion should be suspected and sought in other conditions:

- A fever of unknown origin should raise the possibility of a purulent pericardial effusion as the culprit,
- A newly discovered cardiomegaly in chest X-rays without pulmonary congestion,
- And a sudden deterioration of cardiac function after a cardiac procedure.

The frequencies of the causes of pericardial effusion vary from study to study, in part due to geographic and population variations. After reviewing several studies<sup>1</sup>, the etiologies are as follows:

- Idiopathic 29%
- Malignancy 13%

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• Uremia	6%
• Iatrogenic	16%
• Postmyocardial infarction	8%
• Infection	2%
• Collagen vascular disease	5%
• Hypothyroidism	0%
• Other	21%

Most pericardial effusions never progress to pericardial tamponade; however, bacterial (including mycobacterial), fungal, and HIV-associated infections, neoplastic involvement, and any form of bleeding into the pericardial space may progress to cardiac tamponade. Large effusions related to acute idiopathic pericarditis are not usual; nevertheless, this form of pericarditis accounts for a significant percentage of tamponade cases because of its high frequency.

### Clinical Presentation

Slowly developing pericardial effusions are usually asymptomatic because they do not cause a significant elevation of intrapericardial pressures<sup>2</sup>. In fact, many are discovered when a chest radiograph is ordered for some unrelated reason. In some instances, patients may complain of a constant dull ache or pressure in the chest; this is more common in patients with tamponade, and they are almost always more comfortable when sitting forward. Patients may present with other symptoms related to the space-occupying effects of the pericardial fluid on the other organs in the thoracic cavity: such as dyspnea from lung compression and atelectasis, dysphagia from esophageal compression, hiccups from compression of the phrenic nerve, and nausea and abdominal fullness from pressure on abdominal organs.

A careful physical examination should be performed since it may show important signs that not only suggest the diagnosis, but also point to the etiology of the effusion. In the absence of a tamponade, the physical examination may be normal except for a pericardial rub. If the effusion is large, heart sounds may sound muffled and the apical impulse may be difficult to palpate. Bronchial breath sounds and egophony below the angle of the left scapula due to bronchial compression may also be found. In patients presenting with a tamponade, we can find signs that reflect a reduced cardiac output, such as tachypnea, tachycardia, peripheral cyanosis, and hypotension. Pulsus paradoxus (a fall of 10 mmHg or more in systolic blood pressure during inspiration) is a diagnostic finding; however, if the cardiac output is low, a pulsus paradoxus may only be detected with an arterial catheter. Jugular

venous distention is invariably present and peripheral venous distention can be seen in the scalp, forehead, and ocular fundi. The examination of the venous waves is also helpful because the normal diastolic y descent (related to the decline in right atrial pressure after the tricuspid valve opens) is absent. These findings are not specific given that they can also be found in other conditions, such as massive pulmonary embolism, pulmonary hypertension, right-sided myocardial infarction, and obstructive lung disease.

### Pathophysiology and Hemodynamics

As said earlier, the signs and symptoms associated to pericardial effusion and cardiac tamponade are related to an increase in intrapericardial pressure. The intrapericardial pressure is dependent on various factors:

- The rate of fluid accumulation,
- The volume of fluid,
- The distensibility of the pericardium,
- And the distensibility of the ventricular chambers

The normal pericardium contains around 50 mL of fluid and is able to accommodate slight variations in volume without a significant change in intrapericardial pressure. Various studies have shown that the constraint pressure of the normal pericardium is roughly equal to that of the right atrial pressure<sup>3</sup>. The rapid accumulation of more than 150 mL of fluid is associated with a steep rise in intrapericardial pressure. This rise offsets the myocardial transmural pressure, which is the difference between the pericardial and the intracardiac pressure. As transmural pressures approaches zero, the stroke volume falls; it is at this point that compensatory mechanisms ensue, principally a beta-adrenergically increase in heart rate, ejection fraction, and peripheral resistance. As impairment of cardiac filling becomes more severe, the patient develops hypotension and shock<sup>4-6</sup>.

There are other variants of the classic presentation of tamponade:

- Low-pressure tamponade: this event may occur in a patient with a preexistent pericardial effusion of no clinical significance who has a decrease in blood volume, making said effusion into one capable of hemodynamic compromise, e.g. hypovolemia after diuresis, or hemorrhage.
- Hypertensive cardiac tamponade, is secondary to a beta-adrenergic drive and occurs with excessively high blood pressures
- Regional cardiac tamponade, occurs when a region of the heart is compressed by a loculated effusion.



The findings of cardiac tamponade are usually found in the affected region only, although in some cases the whole heart may be involved. This type of tamponade may be seen after cardiac surgery or after right ventricular infarction.

## Laboratory Testing and Diagnosis

### 1. *Electrocardiogram*

The two most common findings are low voltage, due to impaired transmission across the pericardial fluid, and electrical alternans, a phenomenon caused by swinging of the heart from beat to beat

### 2. *Chest radiograph*

An enlarged cardiac silhouette may be seen with moderate and large effusions (more than 250 mL). On a lateral chest X-ray, the pericardial fat sign may be found. The pericardial fat sign is a linear lucency more than 2 mm from the lower heart border, indicating separation of the parietal epicardial fat from the epicardium

### 3. *Echocardiography*

Transthoracic echocardiography is the tool of choice, both for diagnosis and follow up of pericardial effusions<sup>7-8</sup>. It is a fast, non-invasive procedure that allows accurate diagnosis, safe and adequate drainage of the effusion, and quantitative/qualitative assessment after treatment. A finding on two-dimensional echocardiography is an echo-free space between the visceral and parietal layers. The size of the effusion can be estimated as follows:

- Small effusions (less than 100 mL) tend to localize at the posterior wall and measure less than 1 cm in width
- Moderate effusions are those that surround the heart, but still measures less than 1 cm at its greater width, usually 100-500 mL
- Large effusions (more than 500 mL) are those with more than 1 cm at its greater width

The motion of the parietal pericardium is decreased, and if the effusion is large, the entire heart can be seen swinging in the pericardium thus causing electrical alternans on the electrocardiogram. In the presence of tamponade, additional echocardiographic signs can be appreciated:

- Right atrial collapse which starts in late diastole and extends into systole. It is a very sensitive sign, but not as specific. Increased duration of collapse increases the specificity.
- Right ventricular collapse is seen as an inward movement of the right ventricular free wall in

diastole. This is not as sensitive as right atrial collapse, but much more specific.

- Left atrial collapse can be found in 25% of patients and it is a highly specific sign for tamponade<sup>1</sup>

### 4. *Transesophageal Echocardiography*

It is indicated in the postoperative patient in whom tamponade is suspected, but without a significant amount of fluid seen in the pericardium. It is in these cases that a loculated effusion should be sought, such as hematomas, and transesophageal echocardiography is an excellent tool for detecting such phenomena.

### 5. *Right Heart Catheterization*

It is also an excellent resource, not only for diagnosis, but also for evaluation of hemodynamic compromise and reassessment following therapeutic procedures. Classic findings include equalization of right arterial pressure, pulmonary capillary wedge pressure (PCWP), pulmonary artery diastolic pressure, and right ventricle mid-diastolic pressure.

## Therapy

The therapy of pericardial effusions depends on the etiology, volume, and hemodynamic compromise<sup>9</sup>. In the absence of tamponade, management is non-aggressive. Examples of such patients include those being followed for a known pericardial disease with a small effusion, those with an incidental finding of a pericardial effusion on two dimensional echocardiography, or those found with an enlarged silhouette on a chest X-ray. In the majority of cases, a thorough history and physical examination make the etiology fairly clear, as would be the case of a patient with collagen vascular disease, malignancy, uremic syndrome, or past history of radiation therapy. If the cause of the pericardial effusion is uncertain, a thorough assessment should be made; including screening for neoplastic diseases, rheumatologic disorders, hypothyroidism, and skin testing for tuberculosis, as well as HIV testing in at-risk individuals. In this class of patients, pericardiocentesis need only be done for diagnostic purposes, and even so, the diagnostic yield is very low.<sup>2</sup>

Patients with large pericardial effusions that remain asymptomatic and stable are a special population; this kind of effusions is classified as chronic. Clinical studies have shown that these effusions do not usually reaccumulate after pericardiocentesis and that only a minority of patients progress to tamponade. Therefore, a sensible approach would be to evaluate for specific etiologies, followed by a course of an NSAID, colchicine, or corticosteroids since these medications will shrink some



of these effusions, and if there is no response, a closed pericardiocentesis could be performed.

The treatment for patients presenting with an impending or actual tamponade is much more aggressive<sup>10</sup>. These patients should be immediately admitted to receive both hemodynamic and echocardiographic monitoring as stated earlier. Placement of a pulmonary artery catheter is useful for the initial and subsequent monitoring of pericardial effusion and/or tamponade; however, its placement should not delay treatment if it is emergent. Medical treatment options include intravenous hydration and the use of positive inotropes. Increasing the volume may only help those individuals who are hypovolemic, since increasing intracardiac pressure will also increase pericardial pressure and reduce the transmural pressure even further. On the other hand, the idea of inotropic support for cardiac tamponade is aimed at maximizing the compensatory mechanisms of the heart. However, this may not work because when a patient presents with cardiac tamponade, endogenous inotropic stimulation of the heart is often maximal. Intravenous hydration and the use of positive inotropes are only temporary measures and should not delay pericardiocentesis.

Closed pericardiocentesis (under continued echocardiographic guidance) is the treatment of choice for essentially every case of cardiac tamponade. The needle (16 or 18 gauge) is usually inserted between the xiphoid process and the left costal margin at a 15-degree angle to bypass the costal margin, and then aimed toward the left shoulder, until the pericardium is pierced and fluid is aspirated. It is imperative for the physician to establish that there is a sufficient amount of fluid, large enough to be causing the symptoms. Loculated effusions and effusions containing clots increase the risks of closed pericardiocentesis, mainly perforation of the ventricle; in these instances an open approach is more desirable, both for safety and to obtain pericardial tissue and create a pericardial window.

After pericardial fluid is obtained, it can be analyzed, but it is only recommended in patients in whom an etiology was not known before fluid removal. Routine analysis includes specific gravity, white blood cell count and differential, hematocrit, and protein content. Chylous effusions can be seen after traumatic or surgical injury to the thoracic duct or obstruction by a neoplastic process. Cholesterol-rich effusions may be seen in severe hypothyroidism. Pericardial fluid should be routinely stained and cultured for bacteria, including tuberculosis, and fungi. Also as much fluid as possible should be sent for diagnosis of malignancy, since it has a reasonably high diagnostic yield. Levels of adenosine deaminase

should be routinely tested since it has high sensitivity and specificity for tuberculous pericardial disease.

## Resumen

Las efusiones pericárdicas son un fenómeno relativamente común, debido en gran parte a la gran variedad de posibles etiologías. Aunque una cantidad considerable de casos son idiopáticos, un buen historial y examen físico revelarán la causa en la mayoría de los casos. Las herramientas más efectivas con las que contamos, la ecocardiografía y el cateterismo del lado derecho del corazón, deben ser dirigidas no solo al diagnóstico, sino a la evaluación de la severidad de la efusión, ya que esto va a determinar el tratamiento individual de cada paciente. Una efusión pericárdica pequeña de origen conocido puede ser tratada conservadoramente, tratando la causa subyacente y con un monitoreo cercano para detectar a tiempo un deterioro en la condición clínica del paciente. Las efusiones pericárdicas grandes pueden ser tratadas con pericardiocentesis cerrada luego de una evaluación de rutina para determinar la etiología. Aquellos pacientes que presentan con tamponada cardiaca deben ser tratados con pericardiocentesis cerrada o abierta en carácter de emergencia, dependiendo de las características de acumulación del líquido, y estos procedimientos no deben ser postergados en espera de tratamiento médico. La evaluación rutinaria del líquido pericárdico sólo se debe efectuar en aquellos pacientes en los que no se determinó una causa antes de hacer la pericardiocentesis.

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