

CONSTRICTIVE PERICARDITIS

Definition

Constrictive pericarditis is due to fibrous thickening and/or calcification of the pericardial sac with resultant abnormal diastolic filling with raised filling pressures.

Aetiology

Idiopathic, cardiac surgery, and mediastinal radiation therapy are the main causes in the western world, whereas *tuberculosis* is a major cause in immunosuppressed patients and, especially, developing countries.^{1,2} More rare causes of constrictive pericarditis include *connective tissue disorders, neoplasias, asbestosis, sarcoidosis, trauma, drugs, and uremic pericarditis*. Constrictive pericarditis is a relatively rare complication of viral or idiopathic acute pericarditis (< 0.5%) but, in contrast, is relatively frequent for specific etiologies, especially *bacterial*.³

Pathophysiology

In constrictive pericarditis, diastolic filling is restricted by a non-compliant, inflamed, scarred, or calcified pericardium, after an initial expansion of the myocardium. This results in dissociation of intracardiac and intrathoracic pressures during respiration, and interdependence of ventricular filling. On inspiration, intrathoracic pressure decreases but is not transmitted to the left atrium. A reduced pulmonary vein to left atrium pressure gradient produces a fall in flow into the left atrium and left ventricle. Decreased left-ventricular filling during diastole allows more room for right-ventricular filling, which leads to a septal shift and an increase in right sided inflow. The exact opposite sequence occurs in expiration.⁴ Rapid completion of ventricular filling in early diastole may result in the typical ventricular diastolic waveform of dip and plateau (square root sign) configuration and resembles restrictive cardiomyopathy. Increased ventricular interdependence and discordant changes in LV and RV systolic pressures during respiration are features of pericardial constriction, and are useful from differentiation from restrictive cardiomyopathy (Figures 1 and 2).

Presentation

Patients usually present with symptoms signs of right heart failure such as increased JVP, and peripheral edema, in the absence of significant left ventricular systolic dysfunction or valve disease. However, symptoms of left ventricular failure such as dyspnea on exertion may also

appear. A history of pericarditis, cardiac surgery or irradiation may be derived within the previous 3-12 months. Rarely constriction may appear within days after cardiac surgery.

Physical Examination

JVP is elevated with a prominent y' descent (Friedrich's sign) in sinus rhythm.

Kussmaul's sign, ie a rise or failure of JVP to decrease with inspiration, may be present, typically occurs in constrictive pericarditis.

Pericardial knock may be present but is difficult to distinguish from an S₃. Both coincide with the nadir of the y' descent.

Hepatomegaly (pulsatile liver may be felt), **ascites**, **pleural effusions**, and significant **exercise intolerance** are seen in progressed disease.

Investigations

Transthoracic echocardiography, Chest X-ray in frontal and lateral views, and CT/CMR are essential. Chest X-ray reveals pericardial calcification in 25% of patients with constrictive pericarditis and is not associated with a specific etiology. However, pericardial thickening and calcification is generally less prominent in non-tuberculous constriction.⁵ **ECG** shows non-specific ST-T changes, and low voltage QRS in approximately 30% of patients.⁶ Conduction abnormalities are more common in restrictive cardiomyopathy.

Echocardiography

Increased **pericardial thickness** may be present (not necessarily) and can better appreciated by transesophageal echocardiography. There is abnormal *ventricular septal motion*, and dilatation and absent or **diminished collapse of the IVC** and hepatic veins may be seen. Preserved or **increased early diastolic filling** peak early velocity of longitudinal expansion (peak Ea) ≥ 8.0 cm/s is an important distinction from restrictive cardiomyopathy in which the E is diminished.⁷

A high ratio between right atrial pressure and pulmonary arterial wedge pressure (**RAP/PAWP**) reflects more hemodynamic impact from pericardial constriction, whereas a low ratio indicates more impact from myocardial disease.⁸

Increased hepatic vein flow reversal with expiration, reflecting the ventricular interaction and the dissociation of the intracardiac and intrathoracic pressures.

Respirophasic changes in **pulmonary artery and aorta ejection times** may also be useful. In patients with constrictive pericarditis there is a greater decrease in the PA ejection time, and a greater increase in the aortic ejection time during expiration vs inspiration. Thus, the

difference in ejection times between PA and aorta during expiration vs inspiration is significantly greater in patients with constrictive pericarditis than in those without.⁹

Cardiac Catheterization

It is indicated when non-invasive methods do not provide a definitive diagnosis. Volume challenge may be needed for full expression of hemodynamic signs.

Prominent x descent (occasionally absent) and y descents on the atrial waveform may produce a square root sign or M or W waveforms. Relatively reliable diagnostic criteria are the difference in LVEDP and RVEDP, the ratio of RVEDP to RVESP, and the ratio of RV to LV systolic area during inspiration and expiration (Figure 2).¹⁰ However there is always a degree of overlap that makes application to an individual case difficult.¹¹

Cardiac CT and Cardiac MR

They can demonstrate increased pericardial thickness (>4 mm), and calcification. Up to 20% of patients do not have thickened pericardium.² High sensitivity and specificity has been reported for CMR.^{5,12} Gadolinium delayed enhancement which is indicative of myocardial inflammation or fibrosis is typically absent in constrictive pericarditis, whereas it may be seen in up to one third of patients with restrictive cardiomyopathy.¹¹

Positron emission tomography (PET)

Positron emission tomography (PET) utilizing 18-fluorodeoxyglucose is also useful to assess pericardial inflammation.¹¹

Differential Diagnosis

Differentiation from ***restrictive cardiomyopathy*** is a challenging process.¹¹ Criteria are presented in Table 1 and Figure 3, but no test is definitive. Thickened pericardium, significant respiratory variation in transmitral, pulmonary vein, and tricuspid inflows and preserved indices of myocardial relaxation (velocity of propagation and early mitral annular velocity) are characteristics of pericarditis. In certain cases, endomyocardial biopsy or explorative thoracotomy may still be necessary for a definitive diagnosis. ***Tricuspid regurgitation*** may result in right heart failure and equalization of diastolic pressures simulating constrictive pericarditis. If echocardiography cannot establish the diagnosis, simultaneous recordings of LV and RV pressures in the catheter laboratory reveals that on inspiration the difference between RV and LV EDP becomes more prominent in TR.¹³

Therapy

Medical therapy is palliative by means of removing fluid by diuretics.¹⁴ In chronic constrictive pericarditis surgical complete pericardiectomy is necessary (Figure 4, and Tables 4 and 5), and should be undertaken before calcification occurs but is associated with an

operative mortality of up to 6%.^{15,16} Advanced age, NYHA class and, especially, history of radiation are predictors of a poor outcome.¹⁷ In a subset of patients in whom constriction is due to reversible inflammation, it may resolve after 2 or 3 months either spontaneously or with treatment with anti-inflammatory agents and/or steroids (**transient constrictive pericarditis**). In patients with effusion in the context of constriction (**effusive-constrictive pericarditis**) evacuation of the pericardium may, in some cases, result in resolution of the restrictive physiology.¹⁸ Patients with systemic inflammation as detected by cardiac MRI and biomarkers such as ESR and CRP may respond to anti-inflammatory medication.¹⁹ Complete pericardiectomy is necessary for severe, symptomatic constriction (Table 6). Perioperative mortality is <5%, excluding patients with prior radiation therapy in whom perioperative mortality may exceed 20%.¹¹

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