Constrictive Pericarditis: A review

Hiroshi Imagawa*, M.D, PH.D.

*Corresponding author: Hiroshi Imagawa M.D. PH.D, Department of Regeneration of Community Medicine, Yagi-Nerisurgical Hospital, Japan, Email: imagawa@m.ehime-u.ac.jp

Introduction

Constrictive pericarditis (CP) results from a chronically fibrous thickened pericardium that restricts normal diastolic filling of the heart, depressing systolic function at advanced stage [1,2]. This report presents; 1) pathophysiology of the disease, 2) multimodality diagnosis, and 3) issues of the therapy, mainly.

Anatomy

The pericardium is conventionally divided into serous and fibrous parts. Serous pericardium consists of two layers, visceral and parietal, which form pericardial cavity. The pericardial cavity normally contains less than 50 mL of serous fluid. Hyaluronic acid in pericardial fluid may have the role to lubricate moving surface of the heart and contribute to mechanical support for the contraction of the ventricle [3].

Etiology

Etiology of CP is diverse. It includes idiopathic, infections (tuberculosis, histoplasmosis, Coxsackie virus), neoplasm (lymphoma, carcinoma, melanoma), post cardiac surgery symptoms, connective tissue disease (rheumatoid arthritis, systemic lupus erythematosus), trauma, renal failure, radiation, and foreign body [4]. In many cases, however, the true cause is not identified. Uncommon causes of CP are sarcoidosis, post-myocardial infarction, asbestosis and various causes. Many series of studies have noted a male preponderance [5]. There is no known racial predilection.

Pathophysiology

Many reports describe that CP results from the loss of pericardial elasticity [6,7]. The diseased inelastic pericardium is considered to restrict cardiac chamber expansion and disturb cardiac filling. Structural dilatation is compensatory in the failing heart, though this mechanism is hard to be seen in CP patients [8]. The point is size mismatch between the pericardial sac and cardiac chamber. Though pericardial space may dilate in congestive heart failure patients, pericardial constriction is usually associated with an almost normal-sized heart. The size mismatch and inelastic pericardium facilitate development of congestive syndrome in CP hemodynamic.

The adhesive power between the visceral and parietal layers of the pericardium is another factor. Constrictive pericarditis patient has no pericardial space, normally formed by the parietal and visceral pericardia. Histological examinations have revealed that signs of inflammation (calcification, focal fibrosis, granulation tissue, fibrin deposition, granulomas, and hemosiderin deposition) are common in pathology specimens of CP [9]. Jiamsripong et al. found pericardial-epicardial adhesion itself impaired the efficiency of diastolic filling using vortex formation time [10]. Inflammation transform to adhesion, which is a highly likely process, though not proven. Despite being a primary pericardial disorder, myocardial atrophy can also occur in isolated CP11). Constrictive pericarditis is definitely a heterogeneous disease.
The morbidity of cardiac filling caused by diseased pericardium would be affected by three factors; 1) pericardial elasticity, 2) size mismatch between pericardial sac and heart dimension, 3) adhesion power between the visceral and parietal layers of the pericardium.

**Clinical Presentation**

The classic presentation of CP is symptoms of right-sided heart failure which include ascites, hepatomegaly, and leg edema [12]. In some patients, ascites occurs early before edema of extremities (ascites praecox). Kussmaul’s sign (venous pressure fails to decrease with inspiration) may be positive but it lacks specificity. Fatigue, dyspnea, and pleural effusions secondary to low-cardiac output or pulmonary congestion may be present. Symptoms of the causal diseases of CP (tuberculosis, chronic renal failure, and so on) may affect the condition in a patient.

One of the most crucial clues for accurate diagnosis would be the clinical suspicion about CP presence in patients with signs and symptoms of right sided heart failure that are disproportionate to pulmonary or left sided heart disease.

**Multimodality Diagnosis**

Pericardial anatomy, effusion, thickness, calcification, and inflammation as well as distribution of thickness can be assessed reliably by echocardiography, computed tomography (CT), and magnetic resonance imaging (MRI). Normal pericardial thickness is found to be 2 mm or less; thickness greater than 4 mm suggests pericardial constriction [13]. However, normal pericardial thickness does not necessarily precludes potential presence of CP [14].

**Electrocardiography**

There are no specific signs of CP on electrocardiography which may reveal nonspecific ST changes and low voltage. Advanced and long-standing cases may show atrial fibrillation.

**Chest X-ray**

The cardiac size may be normal or only mildly enlarged. Pericardial calcifications are visible on plain films in dozens of percent of cases.

**Laboratory test**

The specific abnormal value is not recognized in CP. The underlying etiology may influence laboratory test results.

**Echocardiography with doppler**

Many guidelines have recommended the use of echocardiography for diagnosis of CP and any other pericardial disease [16,17]. Two-dimensional echocardiography may show increased pericardial thickness with or without calcification. Predilection sites of these findings may be from annulus to ventricular side. Restricted small ventricle and compensatory biatrial enlargement are usually observed. Echocardiography also reveals dilation and diminished collapse of the inferior vena cava (plethora; a sign of elevated right atrium pressure).

In CP, mid and late diastolic filling is reduced as a result of the rigid pericardium, although early diastolic filling remains unimpeded. Echocardiography shows high early (E) velocity and shortened deceleration time in mitral flow velocity, which may be observed as restrictive LV and RV diastolic filling pattern [18]. An early diastolic septal notch may be seen on M-mode echocardiography.

Inspiration maneuvers in echocardiography reveal inspiratory bouncing motion of the interventricular septum (septal bounce) [19,20]. Jogia et al. has suggested CP patients show different pattern of interventricular septum depending on the severity of constriction physiology [21].

In recent studies of tissue doppler imaging, it has been shown that longitudinal axis expansion in the lateral mitral annulus, a peak early diastolic lateral annulus velocity (e’), and lateral/medial e’ ratio can discriminate between CP and restrictive cardiomyopathy with high sensitivity and specificity [22]. Circumferential deformation, untwisting velocity, and longitudinal strain assessment by speckle tracking echocardiography may be valuable in differentiating CP from restrictive diseases, though further studies are required to confirm these findings [23].

**Cardiac catheterization**

Hemodynamic assessment using high-fidelity manometer-tipped catheters has been the gold standard diagnostic test. In spite of being invasive, catheter measurements remain stronghold tool in the diagnosis of CP [24]. Hemodynamic alterations at rest include ‘M or W’ shaped atrial waveforms, ‘dip & plateau’ in ventricles; early dip in diastolic pressure followed by plateauing in mid-late diastole, and near-equalization of right and left heart filling pressures [25]. These features are not sufficiently specific for CP.

It is useful to assess respiratory changes in ventricular filling such as variation in right atrium pressure, gradient between pulmonary capillary wedge pressure and minimum left ventricle diastolic pressure, and ‘ventricular discordance’, i.e. filling of one ventricle out of to the other ventricle, in order to discriminate CP from other abnormal filling heart disorder such as restrictive cardiomyopathy [26].

In CP patients with atrial fibrillation, pressure measurements in the catheterization laboratory fluctuate with varying RR intervals, making proper assessment of respiratory hemodynamics difficult.

**Computed tomography**

Computed tomography (CT) is a highly accurate method of estimating pericardial thickness. Findings
suggestive of CP on CT include pericardial calcifications, a pericardial thickness of 4 mm (diffuse or localized), narrowing and tubular deformation of the RV, almost normal ventricular size, and straightening of the interventricular septum. Absence of calcifications does not rule out constriction [27].

CT can be useful in the preoperative planning of pericardiectomy by detailing the location and severity of pericardial thickening and calcification.

Magnetic resonance imaging
Pericardial thickening over 4mm can be detected by magnetic resonance imaging (MRI), though its calcification may not be visualized on MRI images. An elongated and narrowed right ventricle, right atrium enlargement, and abnormal septal motion are CP findings on MRI similar to CT. Real-time cine sequences of MRI detect abrupt cessation of diastolic filling, septal bounce, or respirophasic variation in septal excursion [28]. MRI myocardial tagging sequences may reveal pericardial-myocardial adherence [29].

Differential diagnosis
In patients with constrictive physiology, differential diagnosis between pericardial restraint, myocardial restriction, or both, is an annoying issue. Diagnosis of CP is often a challenge because it is frequently mimicked by restrictive cardiomyopathy. Differentiating CP from restrictive cardiomyopathy is of importance since the former has excellent response to surgical pericardiectomy. Dynamic changes with respiration occur in CP patients but not in patients with restrictive cardiomyopathy [30].

Treatment
Medical
Some cases of inflammatory CP may be transient and resolve spontaneously or with anti-inflammatory medications, though the disease course is chronic and progressively deteriorates in most cases [31]. It is not possible for any physician to predict whether a patient under his/her charge would recover. Medical treatment may palliate symptoms, but surgical maneuver is the only definitive therapy.

Surgical
Commonly median sternotomy and left (or bilateral) thoracotomy are used for surgery[32]. Procedure using circulation support permits greater mobilization of the heart, facilitating more-extensive pericardiectomy and dissecting off constricting epicardium, though the recent advances in beating heart surgery help discontinued use of cardiopulmonary bypass.

Pericardiectomy is performed depending on the extent of diseased pericardium. Some surgeons report that anterior “phrenic to phrenic” decortication results in acceptable outcomes and minimizes risk [33]. Others suggest the possibility that patients may develop progressive constriction of the remaining posterior and diaphragmatic pericardium [34].

In the surgery it is highly important to judge, through diagnostic assessment about the constrictive physiology of the patient, whether the extent of decortication is enough or not, and the operation procedure is appropriate. The author reported the intraoperative pressure measurement of right ventricle using a pulmonary balloon catheter equipped with a right ventricle lumen and a 0.15Fr high-fidelity manometer guide wire [35]. Using this technique, surgeons can judge whether the operation brings about the hemodynamic improvement of the constriction physiology. The scope of decortication procedure should be extended until the ‘dip & plateau’ pressure pattern disappears. If the abnormal pressure pattern does not fade out, field of pericardiectomy should be widened or other constrictive factor be considered.

In the decortication procedure, it is crucially important not to damage the coronary arteries, which usually run just under the visceral layer of serous pericardium and adhere to the parietal layer and fibrous pericardium. Surgeons should be aware of that pericardiectomy could be hazardous to the patient because of the proximity to the epicardial vessels.

Survival and Prognosis
Surgical pericardiectomy has a perioperative mortality rate of 8 to 15 %, which, however, varies significantly with etiology and patient conditions [36,37]. Pericardiectomy for treatment of CP has a long-term result with a survival rate of 49 to 71 % at 5 years [34,37]. The outcome after decortication for treatment of CP depends on the underlying etiology, pulmonary artery pressure, left ventricular systolic function, New York Heart Association functional class, and age [38,39]. Among others, NYHA functional class IV among others is found to be a significant predictor of poor postoperative outcome. Delay in surgical treatment makes prognosis worse for patients. Medical management has not been helpful in the management of CP. Surgical pericardiectomy is highly effective and potentially curative for heart failure and remains to be the only effective treatment for this potentially curable disease.

Conclusion
Constrictive pericarditis is a form of heart failure associated with constrictive physiology. It is emphasized that every patient presenting with right heart failure should be examined for CP using multimodality diagnostic tools. These investigations are so important, because a surgical operation will be curative when an appropriate diagnosis is made without missing a necessary timing.

The most important diagnostic key is the clinical suspicion of CP in a patient with signs and symptoms of right sided heart failure that are disproportionate to pulmonary or left sided heart diseases.
Statement of Conflict of Interest

The author has no conflicts of interests with regard to this publication.

References