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# Effusive-Constrictive Pericarditis After Pericardiocentesis

## Incidence, Associated Findings, and Natural History

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## ABSTRACT

**OBJECTIVES** This study sought to investigate the incidence, associated findings, and natural history of effusive-constrictive pericarditis (ECP) after pericardiocentesis.

**BACKGROUND** ECP is characterized by the coexistence of tense pericardial effusion and constriction of the heart by the visceral pericardium. Echocardiography is currently the main diagnostic tool in the assessment of pericardial disease, but limited data have been published on the incidence and prognosis of ECP diagnosed by echo-Doppler.

**METHODS** A total of 205 consecutive patients undergoing pericardiocentesis at Mayo Clinic, Rochester, Minnesota, were divided into 2 groups (ECP and non-ECP) based on the presence or absence of post-centesis echocardiographic findings of constrictive pericarditis. Clinical, laboratory, and imaging characteristics were compared.

**RESULTS** ECP was subsequently diagnosed in 33 patients (16%) after pericardiocentesis. Overt clinical cardiac tamponade was present in 52% of ECP patients and 36% of non-ECP patients ($p = 0.08$). Post-procedure hemopericardium was more frequent in the ECP group (33% vs. 13%; $p = 0.003$), and a higher percentage of neutrophils and lower percentage of monocytes were noted on pericardial fluid analysis in those patients. Clinical and laboratory findings were otherwise similar. Baseline early diastolic mitral septal annular velocity was significantly higher in the ECP group. Before pericardiocentesis, respiratory variation of mitral inflow velocity, expiratory diastolic flow reversal of hepatic vein, and respirophasic septal shift were significantly more frequent in the ECP group. Fibrinous or loculated effusions were also more frequently observed in the ECP group. Four deaths occurred in the ECP group; all 4 patients had known malignancies. During median follow-up of 3.8 years (interquartile range: 0.5 to 8.3), only 2 patients required pericardiectomy for persistent constrictive features and symptoms.

**CONCLUSIONS** In a large cohort of unselected patients undergoing pericardiocentesis, 16% were found to have ECP. Pre-centesis echocardiographic findings might identify such patients. Long-term prognosis in those patients remains good, and pericardiectomy was rarely required. (J Am Coll Cardiol Img 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Pericardial effusion causes a variety of symptoms depending on its acuity and volume, including dyspnea, chest or abdominal pain, hypotension, and cardiac tamponade, which can be fatal (1,2). Pericardiocentesis is the treatment of choice for patients with symptomatic pericardial effusion. Although symptomatology and hemodynamic abnormalities typically improve dramatically after pericardiocentesis, a subset of patients might fail to show resolution of symptoms or may even worsen after pericardiocentesis. This finding is usually associated with the development of typical

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**ABBREVIATIONS AND ACRONYMS**

**CP** = constrictive pericarditis

**CT** = computed tomography

**E** = mitral inflow early diastolic velocity

**e′** = early diastolic mitral septal annular velocity

**ECP** = effusive-constrictive pericarditis

**HV** = hepatic vein

features of constrictive pericarditis (CP). This entity has been previously described as effusive-constrictive pericarditis (ECP) (3-5).

ECP is an uncommon clinical syndrome characterized by the coexistence of tense pericardial effusion and constriction of the heart by the visceral pericardium (3-5). The diagnostic hallmark of ECP is the persistence of elevated right atrial pressure measured by invasive hemodynamic assessment after intrapericardial pressure is reduced to a normal level by pericardiocentesis (5). Pericardiectomy was required in more than one-half of the patients with ECP in previous studies. ECP is most likely part of a natural history of pericardial inflammation that occurs with pericardial effusion. Identification of constrictive features in the post-pericardiocentesis setting is important because such patients require closer follow-up.

Although invasive hemodynamic assessment by cardiac catheterization is the gold standard for the diagnosis of ECP, echo-Doppler evaluation is an important diagnostic strategy for various pericardial diseases, including cardiac tamponade and CP (6,7). It is proposed that ECP can be diagnosed post-pericardiocentesis by 2-dimensional and echo-Doppler demonstration of abnormal ventricular septal motion (due to exaggerated ventricular interdependence) and dissociation of intrathoracic and intracardiac pressures, which are the key features of CP (3). However, limited data have been published on the incidence and natural history of ECP diagnosed by echo-Doppler in a large group of patients. Therefore, we sought to investigate the incidence, echo-Doppler findings, and natural history of ECP detected by echocardiography after pericardiocentesis.

## METHODS

From January 2006 to December 2007, pericardiocentesis was performed in a total of 217 patients at Mayo Clinic, Rochester, Minnesota. Among these patients, 12 did not have echocardiographic images available for review. Hence, a total of 205 consecutive patients who underwent echocardiography before and after pericardiocentesis were included in the present study. These patients were divided into 2 groups based on echocardiographic evidence of CP features after pericardiocentesis (ECP and non-ECP groups). The study protocol was approved by the Institutional Review Board of Mayo Clinic.

Baseline and follow-up information was abstracted from clinical notes. Before pericardiocentesis, comprehensive 2-dimensional and echo-Doppler assessments were performed to evaluate the size, location, and hemodynamic effects of the pericardial effusion, if the hemodynamic status of the patient allowed. In hemodynamically unstable patients, echo-Doppler assessments were limited to obtaining essential information, including the location of pericardial effusion and the ideal entry site for pericardiocentesis. Overt clinical cardiac tamponade was defined by a combination of: 1) pulsus paradoxus >10 mm Hg, systemic hypotension (blood pressure <100 mm Hg), or elevated neck veins; 2) presence of hemodynamic instability believed to be secondary to the pericardial effusion; or 3) the need for emergent pericardiocentesis during invasive procedures (8,9).

Echocardiography-guided pericardiocentesis was performed as previously described by our group (10). To ensure complete drainage of the pericardial fluid, a pigtail catheter was introduced into the pericardial space and kept in place until output was <50 cc over a 24-h period. Follow-up comprehensive echo-Doppler studies were performed to assess for the development of ECP within 1 week of pericardiocentesis. The presence of constrictive features was defined by post-pericardiocentesis echo-Doppler findings of inspiratory decrease and expiratory increase of early diastolic mitral inflow velocity (E) >25% accompanied by at least 1 of the following: expiratory diastolic flow reversal of hepatic vein (HV); respirophasic interventricular septal shift; or augmented early diastolic mitral septal annular velocity (e′) and to a level higher than that of the lateral mitral e′.

Fibrinous pericardial effusion was defined as the presence of pericardial effusion with multiple fibrinous strands. Circumferential pericardial effusion was defined as an effusion that encircled the entire heart. Loculated pericardial effusion was defined as an effusion that was located adjacent to 1 or other heart wall or an effusion that was compartmentalized by pericardial adhesion to the heart wall. Pericardial rind was defined as the presence of diffuse pericardial thickening associated with echolucent soft tissues.

**STATISTICAL ANALYSIS.** The Statistical Package for Social Sciences for Windows, version 13.0 (SPSS, Inc., Chicago, Illinois) was used for statistical analyses. Data are expressed as mean ± SD or median (interquartile range [IQR]; 25th to 75th percentiles) for parametric and nonparametric continuous variables, respectively, and as percentage for categorical data. Chi-square test was used to compare differences in categorical values between the 2 groups. Independent Student *t* test was used to compare differences in parametric continuous variables, whereas Wilcoxon rank sum test was used for nonparametric continuous