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Case Report

CASE REPORT

Grossly elevated plasma BNP does not exclude the diagnosis of constrictive pericarditis

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Abstract

Pericardial effusion with constrictive physiology describes a condition in which the pericardial fluid and thickened and dense pericardium limit left ventricular (LV) diastolic filling and prevent ventricular stretch. This leads to equalization of the end-diastolic pressure in cardiac chambers and poor ventricular filling. We report two patients, who presented with symptoms and signs of severe heart failure and with significantly raised BNP levels who were subsequently diagnosed to have pericardial effusion with constrictive physiology. When VATS pericardial window procedure was performed, the BNP values transiently increased even more in both patients, and returned to pre-operative levels at 5 days post-op. We therefore propose that in contrast to current evidence, grossly elevated BNP levels can coexist with a diagnosis of constrictive pathology. Further studies into constrictive pericarditis should take into account the transient changes in BNP observed in our study that may reveal more regarding the pathophysiology of constrictive pericarditis.

INTRODUCTION

Constrictive pericarditis is a condition where equalization of pressures in all cardiac chambers causes subsequent impaired ventricular filling. Presenting symptoms are usually those of fluid overload and diminished cardiac output. BNP values are traditionally thought to be lower when compared to congestive cardiac failure or restrictive cardiomyopathy. We present two cases of patient with constrictive pericarditis who presented with grossly elevated BNP levels and underwent VATS pericardial window procedures to treat their condition.

CASE REPORTS

A 78-year-old gentleman was admitted to our hospital with a 4-week history of worsening exertional breathlessness. He had a history of long-standing rheumatoid arthritis, diabetes mellitus, ischaemic heart disease and heart failure. He was on treatment with bisoprolol 1.25 mg od, clopidogrel 75 mg od, prednisolone 7 mg OD, furosemide 120 mg od, and insulin Humulin I 30 units mane, 12 units nocte.

On examination, heart rate was 104 and regular. Supine blood pressure (BP) was 109/66 mmHg, oxygen saturation was maintained at 95% on 2 L of inspired oxygen. He had clinical signs of congestive heart failure, with bibasal crepitations on chest auscultation and pitting oedema up to his sacrum. Routine investigations revealed haemoglobin was 11.6 g/dL, WCC 11.1 $\times$ 10^9/L, Na 140 mmol/L, K 3.1 mmol/L, CRP 15 mg/L, creatinine 94 umol/L and urea 7.7 mmol/L.

The 2-D transthoracic echocardiogram demonstrated normal left ventricular (LV) cavity size with mildly impaired LVEF (47% by Simpson's biplane formula). There was mild LV hypertrophy, and grade 2 diastolic dysfunction with mitral respiratory flow

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variation >25%, with no regional wall motion abnormalities and no hepatic flow reversal. Left atrial volume was 38 mL/m^2. In addition there was a septal bounce, a small right ventricle with early diastolic collapse and a dilated inferior vena cava with no significant inspiratory collapse, in keeping with constrictive physiology. There was a moderate pericardial effusion located mainly near the LV maximum at the lateral wall at 3.3 cm.

A chest CT confirmed a thickened pericardium measuring 3.5 mm with a loculated large pericardial effusion. A video-assisted thoracoscopic pericardial window (VATS) procedure was performed for drainage of the effusion. The brain natriuretic peptide (BNP) levels and serum creatinine were measured at pre-op and Days 1 and 5 post-op. BNP levels went from 292 pmol/L pre-op to 732 pmol/L on Day 1 post-op to 286 pmol/L on Day 5 post-op (Chart 1). The pericardial biopsies revealed a dense fibrotic tissue with patchy chronic inflammation. No granulomas or malignant cells were seen. The patient initially did well but deteriorated following spontaneous bowel perforation and passed away during the hospital admission.

A 67-year-old gentleman was admitted with worsening shortness of breath over 5 days. He had previous coronary artery stenting to the left anterior descending coronary artery, hypertension and nephrotic syndrome causing chronic kidney disease (CKD stage 5). He was on treatment with bisoprolol 5 mg OD, omeprazole 20 mg OD, atorvastatin 40 mg ON, aspirin 75 mg OD, bumetanide 4 mg OD, insulin glargine 30 units at night. The investigations revealed haemoglobin of 11.0 g/dL, WCC 4.4 ×10^9/L, Na 140 mmol/L, K 4.8 mmol/L, creatinine 446 umol/L, urea 17.8 mmol/L and CRP 15 mg/L (Fig. 1).

On examination BP was 159/60 mmHg, heart rate regular at 56 bpm and saturation 95% on room air. He had peripheral oedema up to his knees and on auscultation bibasal crepitations.

A transthoracic echocardiogram revealed mild LV systolic dysfunction with LV hypertrophy (EF 47% using Simpson's formula) and abnormal interventricular septal motion and diastolic flattening of LV posterior wall. There were no regional wall motion abnormalities and no hepatic flow reversal. Left atrial volume was 40 mL/m^2. There was early diastolic right ventricular (RV) collapse with significant respiratory variation in the ventricular filling (Fig. 1). There was a pericardial effusion measuring 1.9 cm subcostally anterior to right ventricle, 1.9 cm in apical 4 chamber view anterior to LV and 2.3 cm anterior to RV. On CT chest the pericardial thickness measured 3 mm.

The patient underwent a VATS drainage procedure for pericardial window formation. BNP levels and serum creatinine were measured at pre-op and Days 1 and 5 post-op. BNP rose from 354 pmol/L pre-op to 832 pmol/L on Day 1 post-op and then fell to 301 pmol/L on Day 5 post-op (Chart 1). The patient made an uneventful recovery and his symptoms had resolved at 3 monthly follow up. His BNP at that point had fallen to 208 pmol/L.

DISCUSSION

The cardiac hormone BNP plays an important role in the regulation of blood volume. It is secreted by the atria and the ventricles in normal physiology, is increased in proportion to the severity of heart failure and complements clinical and echocardiographic data in the diagnosis of heart failure [1]. It is secreted in response to ventricular dysfunction and wall stretch and leads to diuresis, vasodilatation and inhibition of the renin–angiotensin–aldosterone system and the sympathetic nerve activity [2, 3].

This study has provided further evidence that in patients with pericardial effusion and constrictive physiology plasma BNP levels can be grossly elevated, in the context of renal dysfuction [4]. Release of the pericardial pressure after the VATS procedure resulted in further increase in the plasma BNP, supporting the hypothesis that in these patients the ventricular stretch appears to be the primary mechanism leading to the further increase in the secretion of plasma BNP.

The grossly raised baseline BNP level may be partly related with the mildly impaired LV function, the presence of reduced renal clearance due to the altered haemodynamics and chronic kidney disease, as well as the presence of bi-atrial dilatation that is commonly associated with constrictive pericarditis (due to increased ventricular filling pressures)

The return of the plasma BNP level to baseline values at Day 5 remains largely unexplained. One explanation is that release of the pericardial constriction allows for greater ventricular stretch, hence, the rise in BNP on Day 1 post VATS procedure. With improvement of cardiac failure, BNP then returns to lower levels as seen on Day 5. Both of our patients had ongoing symptoms of heart failure at Day 5 post-op, which might explain why BNP levels did not return to normal range. In our patient with longer follow-up BNP levels continued to fall at 3 months post-op, albeit remained elevated above normal range.

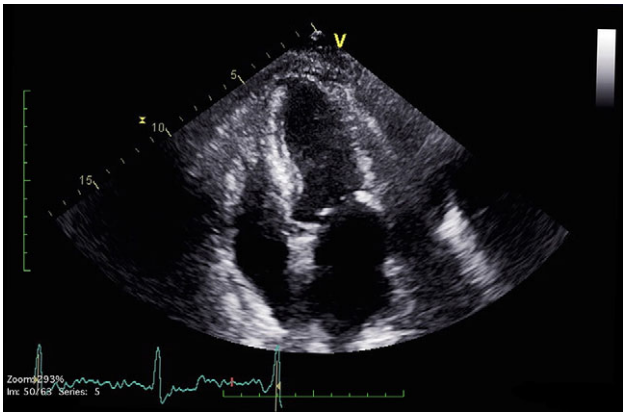

Figure 1: Changes in plasma BNP level following VATS drainage of pericardial effusion and formation of a pericardial window

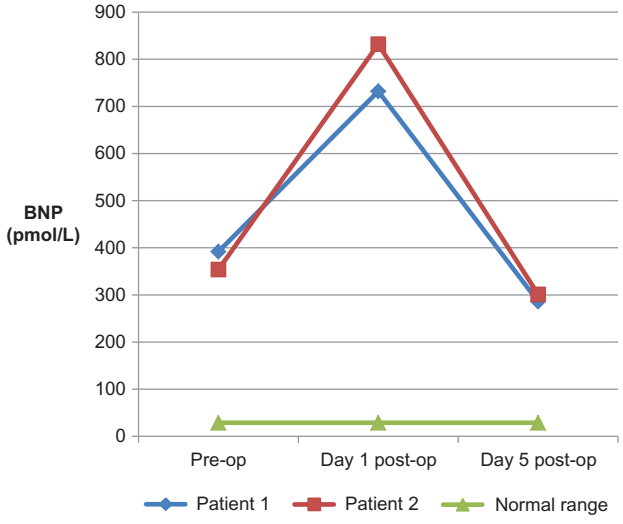

Chart 1: Apical 4 chamber view of transthoracic echocardiogram for patient 1, showing RV diastolic collapse

Previous studies reported the observation that plasma BNP levels are nearly normal in patients with constrictive physiology of heart failure, and grossly elevated in patients with restrictive physiology despite nearly identical clinical and haemodynamic presentation and similarly increased diastolic filling pressures [5, 6]. Additionally Babuinet *et al.* [7] have postulated that BNP levels are lower in idiopathic CP compared to CP after surgery and/or radiotherapy and restrictive pericarditis. Another study has reported elevated plasma BNP levels in patients with tuberculous constrictive pericarditis, that decreased significantly after total pericardiectomy. In their patients, the post-op plasma BNP levels were only measured prior to discharge from hospital [8]. In our study the BNP measurement in the immediate peri-operative period adds to the understanding of the post-op cardiac physiology changes.

We suggest therefore that in contrast to previous studies grossly elevated BNP levels do not exclude a diagnosis of constrictive pericarditis. Additionally, future studies into the role of cardiac peptides in the pathophysiology of pericardial constriction should take into account the above transient changes in the BNP levels.

CONFLICT OF INTEREST STATEMENT

None declared.

ETHICAL APPROVAL

No ethical approval was required.

FUNDING

No funding was received for this study.

PATIENT CONSENT

Consent was obtained from patients involved in the study or next of kin in the case of a deceased patient.

GUARANTOR

Constantinos Missouris.

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