

The role of multi-modality cardiovascular imaging in a patient presenting with acute liver failure secondary to constrictive pericarditis: a case report

Polyvios Demetriades ^{1*}, Rosie Oatham², and Duwarakan Satchithananda ³

¹West Midlands Deanery, Queen Elizabeth Hospital, University Hospitals Birmingham NHS Foundation Trust, Mindelsohn Way, Birmingham B15 2TH, UK; ²Sheffield Teaching Hospitals NHS Foundation Trust, Royal Hallamshire Hospital, Glossop Rd, Broomhall, Sheffield S10 2JF, UK; and ³University Hospitals North Midlands NHS Foundation Trust, Newcastle Rd, Stoke-on-Trent ST4 6QG, UK

Received 26 January 2022; first decision 7 March 2022; accepted 19 May 2022

Background

Constrictive pericarditis is a rare cause of heart failure which often presents a diagnostic challenge to clinicians.

Case summary

We describe the case of a 62-year-old male who presented to our institution with symptoms and signs suggestive of acute liver failure. Abdominal imaging demonstrated congestive hepatopathy. Clinical suspicion despite a 'normal' echocardiogram and sub-threshold NT-proBNP led to multi-modality cardiovascular imaging investigations to determine the cause of the heart failure syndrome. His cardiovascular magnetic resonance scan confirmed ventricular interdependence and extensive late enhancement in the pericardium with associated pericardial effusion. An 18F-fluorodeoxyglucose-positron emission tomography scan confirmed active pericardial inflammation. Cardiac computed tomography showed minimal pericardial calcification. Following confirming the diagnosis of effusive-constrictive pericarditis with evidence of active pericardial inflammation on imaging, a discussion within the Heart multidisciplinary team concluded that a trial of medical therapy with steroids is justifiable to avoid high-risk pericardiectomy. The patient was successfully treated with a combination of ibuprofen, colchicine, and prednisolone resulting in clinical improvement and remission of his symptoms. The imaging investigations were repeated 6 months later and confirmed radiological remission and medical therapy was discontinued.

Discussion

We stress the importance of multi-modality cardiovascular imaging in the diagnosis of constrictive pericarditis and also emphasize its role in identifying the subset of patients who may respond to medical therapy, therefore reducing the risk of high need surgical pericardiectomy.

Keywords

Constrictive effusive pericarditis • Pericardial constriction • Multi-modality imaging • Echocardiography • Cardiovascular MRI • FDG-PET • Liver failure • Case report

ESC Curriculum

2.2 Echocardiography • 2.3 Cardiac magnetic resonance • 2.4 Cardiac computed tomography • 2.5 Nuclear techniques • 6.6 Pericardial disease

* Corresponding author. Tel: +44 7816959513, Email: polyvios.demetriades@nhs.net

Handling Editor: Luke Joseph Laffin

Peer-reviewers: Vincenzo Nuzzi, Mark Abela, and Cemil Izgi

Compliance Editor: Matteo Parollo

Supplementary Material Editor: Mariame Chakir

© The Author(s) 2022. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Learning points

- A high index of suspicion of constrictive pericarditis is required in patients presenting with heart failure syndrome in the presence of an apparently 'normal' NT-proBNP and echocardiogram, particularly in the presence of risk factors for constriction.
- Multi-modality cardiovascular imaging plays a crucial role in the diagnosis of constrictive pericarditis.
- Multi-modality imaging can help identify the subset of constrictive pericarditis patients where inflammation is the dominant pathological mechanism, therefore predicting response to medical therapy and reducing the need for high-risk surgical intervention.

Introduction

Constrictive pericarditis is a rare and often-missed cause of heart failure, characterized by a stiff inelastic pericardium.¹ Diagnosis is challenging—not only is constrictive pericarditis rare, but its clinical presentation is very hard to distinguish from that of restrictive cardiomyopathy or severe tricuspid regurgitation.² Furthermore, no test in isolation can provide definitive diagnostic evidence for constrictive pericarditis.³ Here, we present a case of a patient presenting with acute liver failure, where the diagnosis and management of constrictive pericarditis was guided by multi-modality cardiovascular imaging.

Timeline

Day 0	Admission under the medical team with symptoms and signs of acute liver failure
Day 5	Discharged home after improvement of liver failure symptoms
Day 8	Urgent outpatient cardiology clinic review and re-admission for further investigations and treatments
Day 9	Repeat focused transthoracic echocardiogram is consistent with constrictive physiology. The patient commenced on i.v. diuretics, colchicine, and ibuprofen
Day 11	Cardiovascular MRI shows ventricular interdependence and pericardial late enhancement
Day 12	Cardiac CT shows minimal cardiac calcification
Day 15	FDG-PET showed active pericardial inflammation
Day 17	Following the Heart Team discussion, the patient was commenced on a trial of steroids
Day 25	Patient discharged home following clinical improvement
6 months	Repeat FDG-PET and cardiovascular MRI confirmed radiological remission. Steroids were carefully weaned off

Case presentation

A 62-year-old male, with a background of Type 2 diabetes, peripheral vascular disease, and previous recurrent venous thromboembolism presented with acute confusion of a few hours' duration, following 5 days of worsening abdominal pain. His medication history included

atorvastatin 40 mg, omeprazole 20 mg, and warfarin. Physical examination revealed jaundice, significant ascites, asterixis, and bilateral pitting oedema extending up to his thighs. Cardiovascular and respiratory examination were thought to be otherwise unremarkable, although the patient was not seen by a cardiologist at this point. The initial working diagnosis was acute liver failure complicated by hepatic encephalopathy.

Haematological and biochemical investigations were consistent with acute liver failure, with elevated liver enzymes ALT 1395 (7–55) IU/L and AST 596 (10–40) IU/L. A series of investigations excluded viral hepatitis and other causes of acute liver failure. His NT-proBNP was 231 ng/L (>400 ng/L likely heart failure) and his C-reactive protein 208.2 (0–5) mg/L. Computed tomography (CT) abdominal scanning was arranged to exclude portal vein thrombosis and this demonstrated a heterogeneous appearance on portal venous phase images—a 'nutmeg liver'—consistent with hepatic congestion (Figure 1). The initial echocardiogram [transthoracic echocardiogram (TTE)] was reported as 'normal' apart from a small pericardial effusion. During the initial work-up, the patient was commenced on pharmacological treatment for hepatic encephalopathy with intravenous antibiotics (piperacillin-tazobactam 4.5 g TDS), multi-vitamin replacement (vitamin B substances with ascorbic acid TDS), and lactulose (10 mL BD).

The patient was discharged early after showing some signs of clinical improvement. However, in view of ongoing peripheral oedema, he was referred to cardiology for outpatient review. The presence of

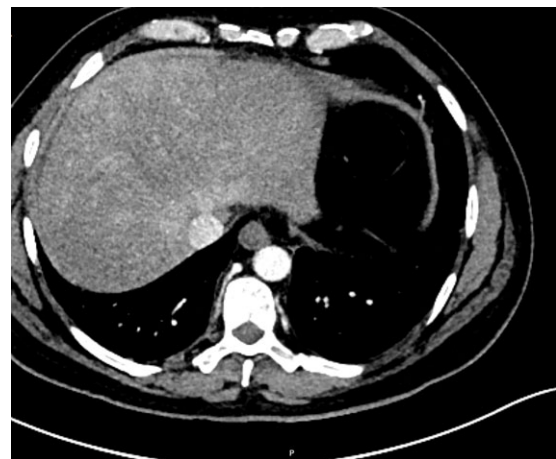


Figure 1 Portal venous phase of computed tomography abdomen demonstrating 'nutmeg liver'. This heterogeneous appearance of the liver is consistent with venous congestion.

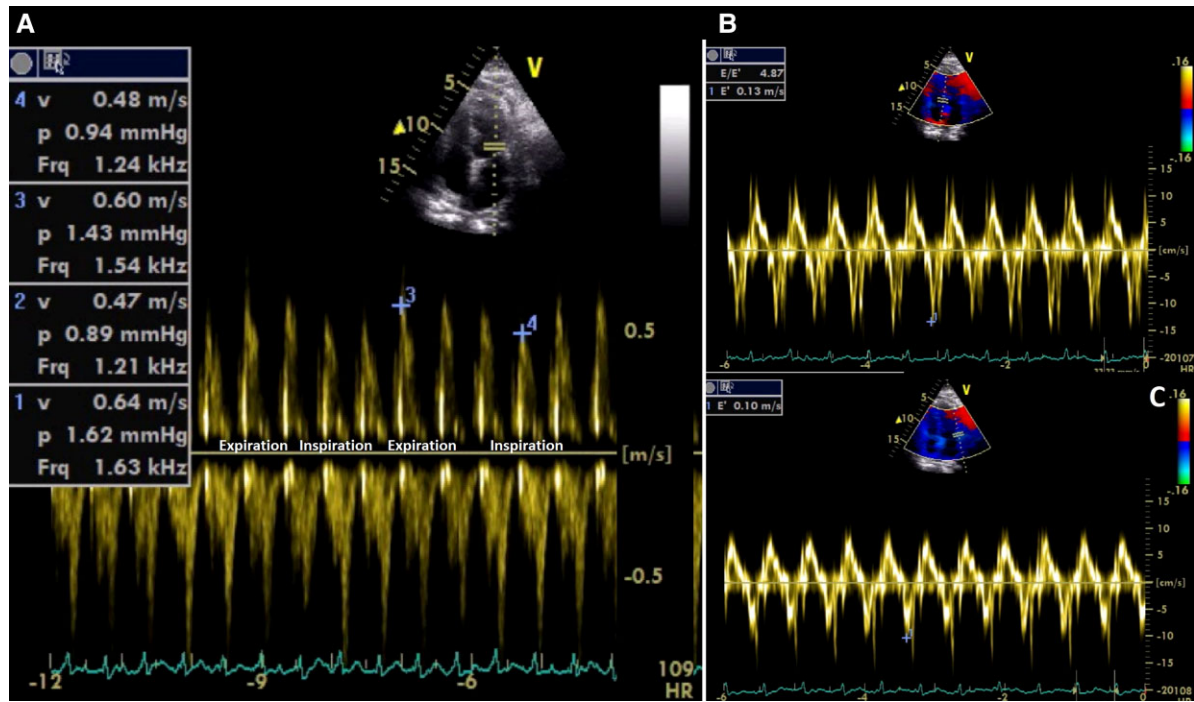


Figure 2 Echocardiography demonstrated significant respiratory variation (27%) in mitral valve inflow velocities between inspiration and expiration (A). Tissue Doppler velocities demonstrated normal E' velocities and annulus reversus with E' septum $>$ E' lateral (B, C).

an elevated pulsatile JVP alongside Kussmaul's sign, and an unexplained sinus tachycardia led to re-admission for inpatient investigations. These were arranged to identify the cause of the heart failure syndrome, despite the apparently 'normal' TTE and NT-proBNP.

A focused TTE was repeated to specifically investigate this. This showed the normal biventricular size and ejection fraction, confirmed the presence of a pericardial effusion, and identified a dilated and non-compliant inferior vena cava. In addition, there was evidence of respiratory phasic ventricular septal shift (see Supplementary material online, Video S1). Mitral inflow velocities demonstrated significant respiratory variation and mitral annular tissue Doppler patterns were consistent with annulus reversus, suggestive of constrictive physiology (Figure 2).

The patient was admitted to the cardiology ward and commenced on intravenous furosemide 40 mg BD, ibuprofen 400 mg TDS, and colchicine 500 μ g BD. To further assess cardiac structure and function, a cardiovascular magnetic resonance imaging (CMR) was performed. This confirmed increased ventricular coupling during free breathing (ventricular interdependence), with left-sided septal motion at the onset of inspiration (see Supplementary material online, Video S2). There was extensive late gadolinium enhancement (LGE) throughout the thickened pericardium, and no enhancement in the myocardium (Figure 3). T2 STIR imaging was performed but was of suboptimal quality.

Cardiac CT identified minimal pericardial calcification. To further assess pericardial disease activity which would determine the appropriate treatment strategy, an 18 F-fluorodeoxyglucose-positron emission tomography (FDG-PET) scan was arranged. This demonstrated uptake in an irregularly thickened pericardium, which was consistent with an inflammatory pathology (Figure 4).

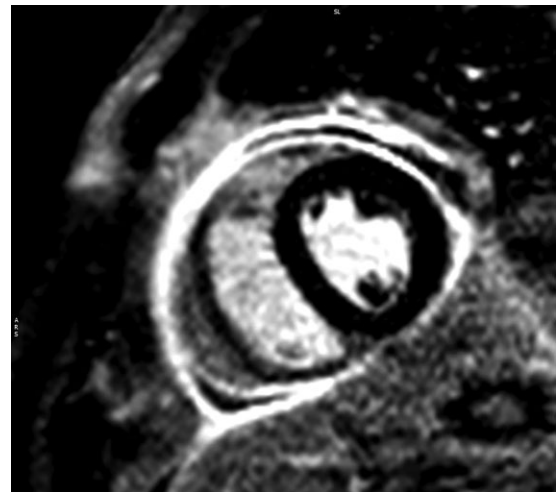


Figure 3 Cardiovascular magnetic resonance imaging late gadolinium imaging (phase-sensitive inversion recovery), short-axis, demonstrating global uptake of the pericardium. There was no enhancement of the myocardium.

A full laboratory work-up including autoimmune and viral screen did not identify any underlying cause of the pericarditis. Underlying malignancy and cardiac tumours were also excluded by CT.

Following confirming the diagnosis of effusive-constrictive pericarditis with evidence of active pericardial inflammation on imaging, a

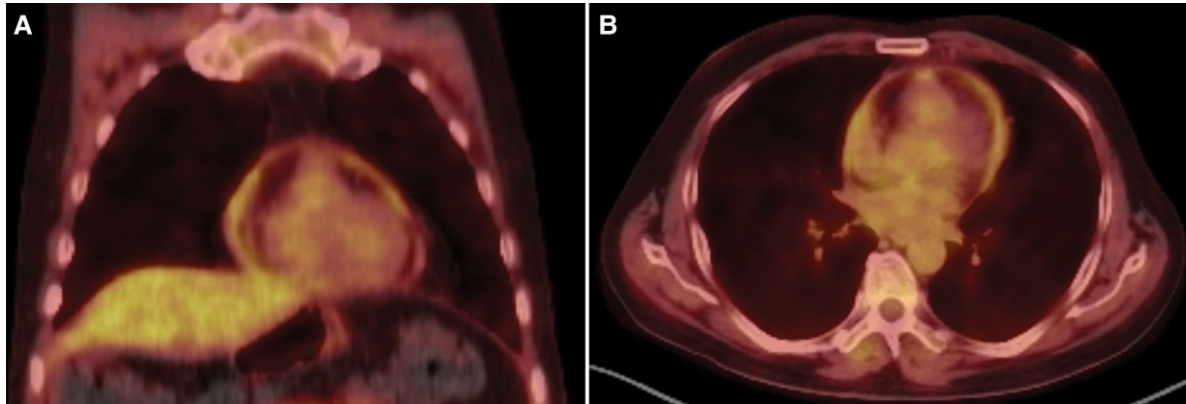


Figure 4 Fluorodeoxyglucose-positron emission tomography demonstrated uptake in the pericardium consistent with inflammation (A, B).

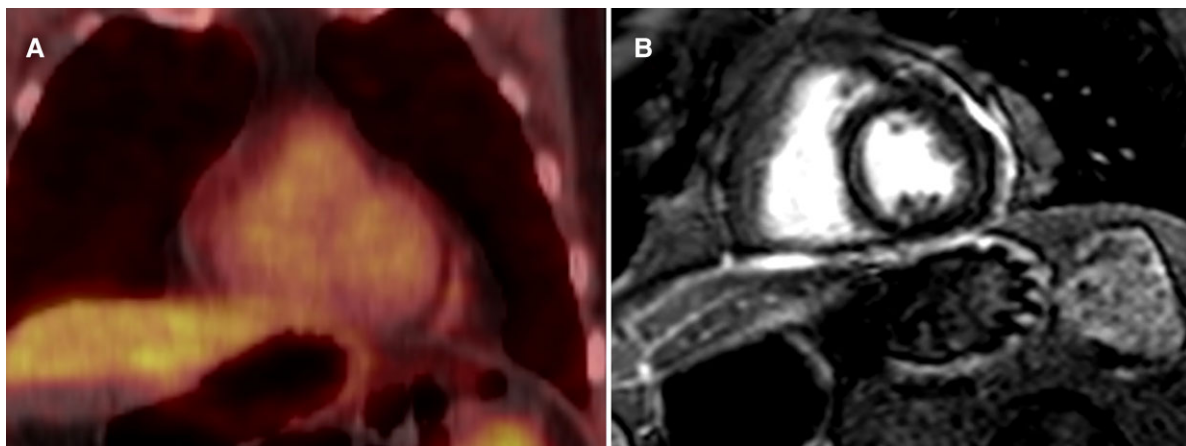


Figure 5 (A) Repeat fluorodeoxyglucose-positron emission tomography following treatment demonstrated reduction in the uptake in the pericardium (B) Repeat cardiovascular magnetic resonance late gadolinium imaging (phase-sensitive inversion recovery) post-treatment demonstrating reduction in the late enhancement of the pericardium.

discussion within the Heart multidisciplinary team concluded that a trial of medical therapy with steroids is justifiable to avoid high-risk pericardiectomy. A regime prednisolone 40 mg OD was introduced.

Anti-inflammatory therapies in conjunction with diuresis resulted in clinical and biochemical improvement. Continuation of colchicine 500 µg BD, furosemide 40 mg, and prednisolone 30 mg as an outpatient resulted in complete resolution of symptoms.

A repeat FDG-PET organized at 6 months post-admission demonstrated a significant reduction in pericardial thickness and metabolic activity (*Figure 5A*). Follow-up CMR demonstrated near resolution of the ventricular interdependence during free breathing (see [Supplementary material online, Video S3](#)) alongside a reduction in the late enhancement of the pericardium (*Figure 5B*). His CRP was 8 mg/L. Based on the encouraging imaging findings, steroids were carefully weaned off over 6 weeks and eventually discontinued.

During the last follow-up visit, 9 months after his original presentation, the patient reported that he was asymptomatic and had

returned to his normal daily activities. He will remain under long-term follow-up due to the risk of recurrence.

Discussion

We describe the case of a patient presenting with acute liver failure, where the high index of suspicion of constrictive pericarditis triggered a series of multi-modality cardiovascular imaging investigations that played a key role in identifying the diagnosis and guided treatment.

The diagnosis of constrictive pericarditis is challenging as patients commonly present with a spectrum of non-specific symptoms. European guidelines state that diagnosis is achieved when signs and symptoms of right heart failure are present in addition to impaired diastolic filling identified by one or more imaging methods, in the absence of myocardial pathology.⁴ Transthoracic echocardiogram is

recommended for all patients, with modalities such as cardiac CT and CMR only recommended as second-level techniques. Invasive testing with cardiac catheterization should be guided by clinical context, or when non-invasive methods fail to provide a definitive diagnosis.⁴ However, complementary modalities such as CMR, cardiac CT, and FDG-PET not only serve as diagnostic tests but also allow assessment of pericardial thickness and calcification and assist in highlighting the haemodynamic consequences of constriction.^{5–7} Finally, imaging can assist in identifying underlying causes of constriction such as cardiac tumours.⁸

Constrictive pericarditis is broadly divided into transient, effusive-constrictive, and chronic, and the risk of developing constriction following acute pericarditis varies with aetiology.⁹ Transient constriction is considered reversible, either spontaneously or following anti-inflammatory therapy.¹⁰ Chronic constriction most commonly requires surgical pericardiectomy.¹¹ Multi-modality imaging enhances diagnostic accuracy by providing insight into pericardial activity, which is vital in guiding intervention.¹² For example, T2-weighted imaging (e.g. T2 STIR) and LGE sequences on CMR allow identification of pericardial oedema and inflammation which are characteristics of pericarditis.^{13,14} These alongside with an absence of significant calcification on CT and the presence of pericardial inflammation on nuclear imaging are predictors of good response to medical therapy.⁷ Despite surgical intervention being the gold standard of treatment for constrictive pericarditis, it should be reserved for patients who fail to respond to medical therapy as removal of the visceral pericardium is a hazardous procedure, with in-hospital mortality rates quoted as high as 12%.¹⁵ In contrast, as demonstrated by our case, medical therapy can achieve a satisfactory resolution of symptoms in a selective cohort of patients with constrictive pericarditis where pericardial inflammation is the dominant pathological mechanism. Multi-modality imaging is therefore key in the management of these patients, as it can help differentiate effusive-constrictive pericarditis from other subtypes, enabling clinicians to steer the most appropriate course of management. Furthermore, imaging provides information about the progression of inflammation, allowing therapy to be tailored as the clinical picture changes.¹⁵

Patient's perspective

The patient expressed his gratitude to the team looking after him as he was able to return to his usual activities without limitation. He was particularly grateful to have avoided surgery, as the reduction in recovery time permitted an earlier return to work.

Conclusions

This case serves to demonstrate the importance of maintaining a high index of suspicion of constrictive pericarditis in patients presenting with heart failure and a sub-threshold NT-proBNP with an apparently 'normal' TTE, particularly in the presence of risk factors for constriction, such as previous cardiac surgery or chest radiotherapy. We encourage clinicians to utilize appropriate multi-modality imaging investigations to allow prompt diagnosis but also guide the management of these patients.

Lead author biography



Polyvios Demetriades (MBChB, BMedSc, MRCP) is a final-year cardiology registrar (ST7) specializing in cardiovascular imaging in the West Midlands Deanery, UK. He is accredited in adult TTE, TOE, and cardiovascular MRI. His work in general cardiology and cardiovascular imaging has been presented in national and international meetings and was published in peer-reviewed journals.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Slide sets: A fully edited slide set detailing these cases and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: None declared.

Funding: None declared.

References

- Welch TD. Constrictive pericarditis: diagnosis, management and clinical outcomes. *Heart* 2018;**104**:725–731.
- Welch TD, Ling LH, Espinosa RE, Anavekar NS, Wiste HJ, Lahr BD, Schaff HV, Oh JK. Echocardiographic diagnosis of constrictive pericarditis. *Cardiovasc Imaging* 2014;**7**: 526–34.
- Bhattad PB, Jain V. Constrictive pericarditis: a commonly missed cause of treatable diastolic heart failure. *Cureus* 2020;**12**:e8024.
- Adler Y, Charron P, Imazio M, Badano L, Barón-Esquivias G, Bogaert J, Brucato A, Gueret P, Klingel K, Lionis C, Maisch B, Mayosi B, Pavie A, Ristic AD, Sabaté Tenas M, Seferovic P, Swedberg K, Tomkowski W, ESC Scientific Document Group. 2015 ESC guidelines for the diagnosis and management of pericardial diseases. *Eur Heart J* 2015;**36**:2921–2964.
- Ansari-Gilani K, Gilkeson RC, Kikano EG, Hoit BD. Multimodality approach to the diagnosis and management of constrictive pericarditis. *Echocardiography* 2020;**37**: 632–636.
- Chetrit M, Xu B, Verma BR, Klein AL. Multimodality imaging for the assessment of pericardial diseases. *Curr Cardiol Rep* 2019;**21**:41.
- Chetrit M, Natalie Szpakowski N, Desai MY. Multimodality imaging for the diagnosis and treatment of constrictive pericarditis. *Expert Rev Cardiovasc Ther* 2019;**17**: 663–672.
- Bussani R, Castrichini M, Restivo L, Fabris E, Porcari A, Ferro F, Pivetta A, Korcova R, Cappelletto C, Manca P, Nuzzi V, Bessi R, Pagura L, Massa L, Sinagra G. Cardiac tumours: diagnosis, prognosis, and treatment. *Curr Cardiol Rep* 2020;**22**:169.
- Imazio M, Brucato A, Mavosi B, Derosa F, Lestuzzi C, Macor A, Trincheri R, Spodick DH, Adler Y. Medical therapy of pericardial diseases: part II: noninfectious pericarditis, pericardial effusion and constrictive pericarditis. *J Cardiovasc Med* 2010;**11**: 785–794.
- Haley J, Tajik A, Danielson G, Schaff H, Mulvagh S, Oh J. Transient constrictive pericarditis: causes and natural history. *J Am Coll Cardiol* 2004;**43**:271–275.
- Chiabrandi JG, Bonaventura A, Vecchié A, Wohlford GF, Mauro AG, Jordan JH, Grizzard JD, Montecucco F, Berrocal DH, Brucato A, Imazio M, Abbate A. Management of acute and recurrent pericarditis. *J Am Coll Cardiol* 2020;**75**:76–92.
- Ohswa N, Nakaoka Y, Kubokawa S, Kubo T, Yamasaki N, Kitaoka H, Kawai K, Hamashige N, Doi Y. Subacute effusive-constrictive pericarditis: echocardiography-guided diagnosis and management. *J Cardiol Cases* 2017;**16**:14–17.

13. Alter P, Figiel J, Rupp T, Bachmann G, Maisch B, Rominger MMR. CT and PET imaging in pericardial disease. *Heart Fail Rev* 2013;**18**:289–306.
14. Feng D, Glockner J, Kim K, Martinez M, Syed IS, Araoz P, Breen J, Espinosa RE, Sundt T, Schaff HV, Oh JK. Cardiac magnetic resonance imaging pericardial late gadolinium enhancement and elevated inflammatory markers can predict the reversibility of constrictive pericarditis after antiinflammatory medical therapy. *Circulation* 2011;**124**:1830–1837.
15. Cho Y, Schaff H, Dearani J, Daly R, Park S, Li Z, Oh JK. Completion pericardiectomy for recurrent constrictive pericarditis: importance of timing of recurrence on late clinical outcome of operation. *Ann Thorac Surg* 2012;**93**:1236–1241.