

# A case report of malignant primary pericardial mesothelioma with atypical imaging appearance: multimodality imaging with histopathological correlation

Audra Banišauskaitė <sup>1</sup>, Antanas Jankauskas <sup>1\*</sup>, Valdas Šarauskas<sup>2</sup>, and Monika Aržanauskaitė <sup>3,4</sup>

<sup>1</sup>Department of Radiology, Lithuanian University of Health Sciences, Eivenių str. 2, Kaunas 50161, Lithuania; <sup>2</sup>Department of Pathology, Lithuanian University of Health Sciences, Eivenių str. 2, Kaunas 50161, Lithuania; <sup>3</sup>Department of Radiology and Imaging, Liverpool Heart and Chest Hospital, Thomas Dr, Liverpool L14 3PE, UK; and <sup>4</sup>Cardiovascular Program ICCC, IR, HSCISP, IIB-Sant Pau, Barcelona, Spain

Received 31 August 2019; first decision 17 October 2019; accepted 28 January 2020; online publish-ahead-of-print 27 February 2020

## Background

Primary pericardial mesothelioma is a rare primary cardiac malignancy, with three main histopathological types, sarcomatoid histotype being the rarest. The imaging features were atypical due to concomitant extensive calcification, which resulted in aggravated differential diagnosis.

## Case summary

A 45-year-old man presented to our hospital with non-specific clinical symptoms. According to clinical history, a mediastinal tumour had been suspected with a previous unsuccessful attempt of transthoracic computed tomography-guided biopsy at an overseas hospital with limited data of performed imaging procedures. Multimodality imaging at our centre revealed extensively calcified solid masses in the pericardium, invading the left atrium. As the imaging features suggested an atypical primary pericardial malignancy, a diagnostic thoracoscopy was performed. Histopathological analysis of specimen revealed sarcomatoid type of pericardial mesothelioma with areas of necrosis and foci of osteogenic differentiation. Despite planned treatment, 2 weeks after histological diagnosis, the patient passed away due to perforated peptic ulcer-related sepsis.

## Discussion

The presence of extensive calcification in the lesion resulted in a challenging imaging workup and diagnosis. Initial differential diagnosis included primary or metastatic calcification-prone tumour, secondary calcification due to haemorrhage after previous interventional procedure and other pathologies, such as tuberculous pericarditis, calcified amorphous tumour, among others. Calcification may be part of the histological tumour characteristics; however, proper history taking is crucial as concomitant diseases, previous treatment, and interventional procedures may alter the imaging pattern.

## Keywords

Case report • Pericardium • Mesothelioma • Multimodality imaging • Pericardial calcification

## Learning points

- Primary pericardial tumours are very rare, resulting in lack of systematic data of their imaging features.
- Calcification of the tumour may be due to its histological properties; however, proper history taking is crucial as concomitant diseases, previous treatment, and interventional procedures may alter the imaging pattern.
- Multimodality imaging helps to effectively narrow the differential diagnoses of pericardial masses.

\* Corresponding author. Tel: +3706574554, Email: [jankauskas.antas@gmail.com](mailto:jankauskas.antas@gmail.com)

Handling Editor: Alberto Aimo

Peer-reviewers: Marco De Carlo and Ciro Santoro

Compliance Editor: Anastasia Vamvakidou

Supplementary Material Editor: Peysh A. Patel

© The Author(s) 2020. 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 Non-Commercial License (<http://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](mailto:journals.permissions@oup.com)

## Introduction

While primary cardiac tumours are very rare, primary pericardial neoplasms are even less frequent, the most common being malignant primary mesothelioma.<sup>1–3</sup> The diagnosis is often delayed due to non-specific and late clinical manifestation.<sup>4</sup> We report an unusual appearance of sarcomatoid pericardial mesothelioma in a 45-year-old man.

## Timeline

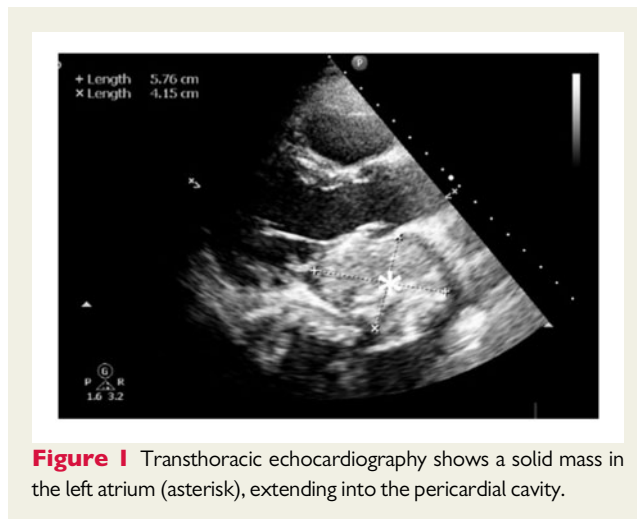
Events	
Six months prior to admission	History of a suspected mediastinal tumour with unsuccessful computed tomography (CT)-guided biopsy, complicated by pericardial tamponade, after which patient rejected further management in the previous hospital, was started on dexamethasone for symptom alleviation
Clinical presentation at admission	Dyspnoea, palpitations, chest pain, peripheral numbness, and hypotension Electrocardiography (ECG): SR, ST-segment depression in leads II, III, aVF, and T-wave inversion in leads I, aVL, and V4–V6
Imaging workup within 2 weeks after admission	Transthoracic echocardiography, contrast-enhanced ECG-gated CT, dedicated ECG-gated cardiovascular magnetic resonance imaging with gadolinium administration
Four weeks after admission	Diagnostic thoracoscopy and subsequent histopathology successfully performed
Five weeks after admission	Histopathological diagnosis of primary pericardial sarcomatoid mesothelioma
Eight weeks after admission	Chemotherapy scheduled Developed a peptic ulcer complicated by peritonitis and sepsis with fatal outcome

## Case presentation

A 45-year-old man presented with a 1-year history of dyspnoea, palpitations, chest pain, peripheral numbness, weight loss, and hypotension. A mediastinal mass had been detected on chest computed tomography (CT) study. A transthoracic CT-guided biopsy was performed in another hospital 6 months prior; however, the procedure was complicated by a cardiac tamponade and the tissue sample was uninformative. The patient then refused further management and was only administered dexamethasone for symptom alleviation. He had no other medical conditions and was not on any other regular medication.

Physical examination revealed bilateral lower leg oedema, a loud systolic murmur, heart rate of 66 b.p.m. and respiratory rate of 23 breaths per minute. The lung auscultation, blood oxygen saturation, and blood pressure were normal (93% and 100/60 mmHg, respectively).

Haematologic and biochemical analyses were unremarkable (in particular, C-reactive protein was 15.9 mg/L (normal range <3mg/L),



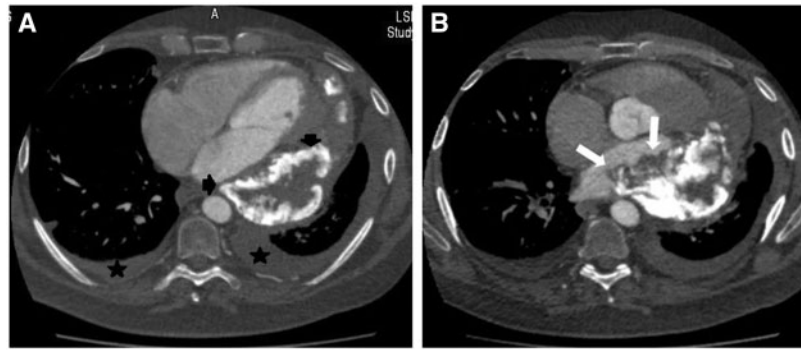
**Figure 1** Transthoracic echocardiography shows a solid mass in the left atrium (asterisk), extending into the pericardial cavity.

troponin I 0.16 µg/L (normal range <0.04 µg/L). Electrocardiography (ECG) showed sinus rhythm, ST depression in II, III, aVF leads, and T-wave inversion in I, aVL, and V4–V6 leads. Chest radiograph revealed left pleural effusion, left lower lobe consolidation, and enlarged cardiac silhouette. Transthoracic echocardiography showed a large (5 × 4 × 2 cm), heterogeneous, hyperechoic mass in the left atrial (LA) projection, extending into the pericardial cavity (Figure 1) with compression of the LA and mild mitral regurgitation. Additionally, there was hypokinesia of the left ventricular (LV) inferior and lateral walls—this was felt to result from limited pericardial adhesions; there were no other features of constriction. LV systolic function was mildly impaired with ejection fraction of 45%. Electrocardiography-gated CT revealed a large (14 × 8 × 12 cm), heterogeneous, contrast-enhancing, markedly calcified pericardial lesion along with the left heart extending into the LA walls, occluded left pulmonary veins and small bilateral pleural effusions (Figure 2). Cardiovascular magnetic resonance (CMR) imaging, performed for further tissue characterization, confirmed a large (14 × 7 × 14 cm) solid pericardial mass extending along the anterior and lateral LV walls, invading the LA with adjacent intra-atrial thrombus (Figure 3). The mass was heterogeneous on T1W with fat saturation (Figure 3A), enhanced after Gadolinium administration (Figure 3B) and had low values on ADC map of diffusion-weighted imaging (DWI) (Figure 3C). The left upper and lower pulmonary veins were invaded. There were satellite pericardial nodules along the right atrial wall and the coronary sinus and a separate nodule in the left cardiophrenic angle.

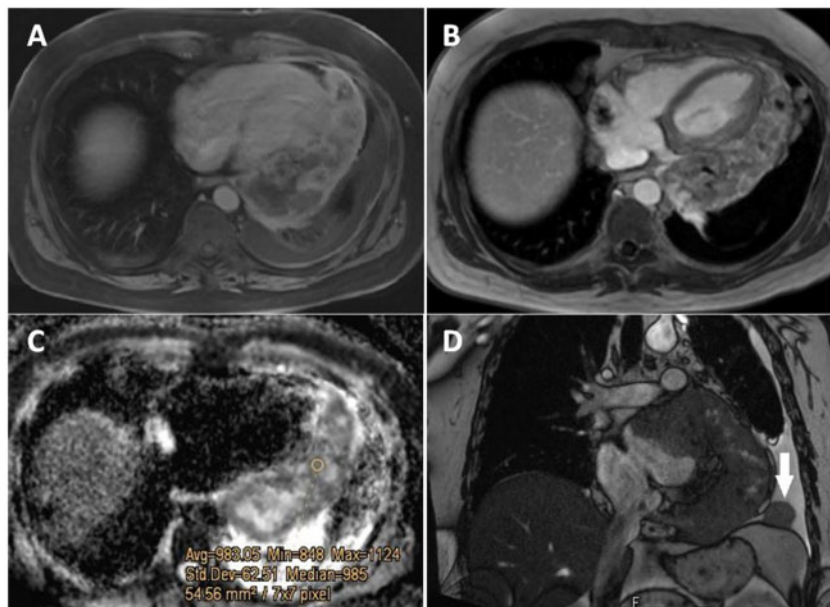
Initial differential entities included primary or metastatic calcification-prone tumour, among them a teratoma or metastatic osteosarcoma. Secondary calcification due to haemorrhage after previous biopsy and other pathologies, such as tuberculous pericarditis were considered.

The benign nature was excluded after CT and CMR showed tumorous tissue plane invasion, pleural effusion, contrast enhancement, and satellite nodules. Moreover, the tuberculosis screen was negative, and abdominal ultrasound study was unremarkable. Due to predominant pericardial location, a primary pericardial malignancy was suggested.

As the previous biopsy was unsuccessful, thoracoscopy was performed to remove the left cardiophrenic angle nodule.



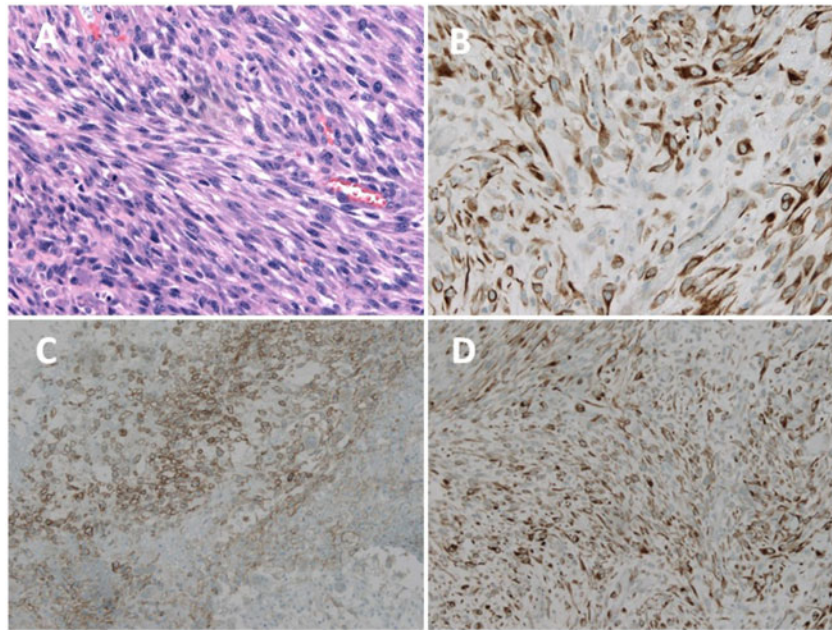
**Figure 2** Contrast-enhanced computed tomography in systemic arterial phase, axial plane in soft tissue window. Solid mass along the left heart with prominent calcifications in the pericardium (A, arrowheads), bilateral pleural effusion (A, stars), and invasion of the left atrium (B, white arrows).



**Figure 3** Tissue characterization by cardiovascular magnetic resonance with electrocardiography-gating and breath-holding in axial (A–C) and coronal (D) planes. A heterogeneous contrast-enhancing solid mass on T1W VIBE with fat saturation (A) and inversion recovery 10 min after gadolinium administration (B) with low values on apparent diffusion coefficient (ADC) map of diffusion-weighted imaging (C) was seen. Additionally, there was a satellite nodule in the left cardiophrenic angle, shown on balanced steady-state free precession (SSFP) image (D, arrow) and a small left pleural effusion.

Histopathology revealed a well-vascularised tumour, formed by polymorphic spindle-shaped cells with a moderate amount of cytoplasm, large oval nuclei, frequent mitoses, some of which were atypical. There were wide necrotic areas and foci of osteogenic differentiation. Immunohistochemistry was positive for cytokeratin, epithelial membrane antigen (EMA), and negative for CD34, S100, smooth muscle actin (SMA), CK20, BCL-2, Anti-TLE, and CD99 (Figure 4). The final pathological diagnosis was thus a primary pericardial sarcomatoid mesothelioma. The tumour anatomically was too advanced for surgical removal and, after multidisciplinary discussion,

appointment with an oncologist regarding chemotherapy was scheduled. During the admission, the patient was treated with dexamethasone (1 mg/day) and diuretics orally (torsemide 20 mg/day and spironolactone 25 mg/day). A week after the histopathological diagnosis, patient's condition worsened due to a development of a left lower lobe pneumonia, which responded well to antibacterial treatment (Sulfamethoxazole–Trimethoprim 400/80 mg/b.i.d.). However, several days later, the patient experienced an acute severe abdominal pain and was diagnosed with peritonitis due to a perforated peptic ulcer (confirmed by esophagogastroduodenoscopy), which may have



**Figure 4** Histological and immunohistochemical analysis of the specimen: spindle shaped cells with frequent and atypical mitoses (A), positive immunohistochemical reaction with cytokeratin 20× (B), positive immunohistochemical reaction with EMA (C), and positive immunohistochemical reaction with cytokeratin 10× (D).

had developed after long-term dexamethasone treatment. Patient underwent abdominal surgery but passed away due to sepsis 2 days later.

## Discussion

Primary pericardial mesothelioma (PPM) is an exceedingly rare malignant tumour (prevalence of <0.0022%) and accounts for 2–3% of primary cardiac and pericardial malignancies.<sup>3,5</sup> Sarcomatoid histotype is the rarest, while epithelial and biphasic histotypes are more common (~75–80% of all PPM cases).<sup>6</sup>

Primary pericardial mesothelioma can form a local solid tumour, plaque-like pericardial thickening or diffusely infiltrate the pericardium and adjacent structures.<sup>7</sup>

Although some pleural osteoblastic sarcomatoid mesotheliomas have been reported to have osteoid components,<sup>8</sup> primary calcification of PPM is not typical. Thus a possible reason for calcification in our case was a component of a chronic iatrogenic haematoma after the first biopsy. Haematoma, experimentally produced in animals by injecting blood into pericardium, resolves without calcification.<sup>9</sup> Calcified haematomas occur mainly after high energy trauma, which is believed to alter processes of fibrinolysis and absorption.<sup>10</sup>

Extensive calcification may mask imaging features of vascularity and can lead to a false-positive diagnosis of tuberculous pericarditis. Other calcification-prone lesions, such as calcified amorphous tumour,<sup>11</sup> were excluded due to atypical location and morphology.

Echocardiography is the first-line investigation to assess for pericardial constriction as per ESC guidelines<sup>12</sup>; it is useful to differentiate fluid from solid tumours, including biphasic or sarcomatoid type pericardial mesotheliomas.<sup>13</sup> However, it is challenging in distinguishing epithelial PPM from fluid—both are anechoic.<sup>14</sup>

Cross-sectional imaging can provide structural and functional information about the pericardium and heart in any anatomical plane has greater soft-tissue contrast than echocardiography and is less operator-dependent.<sup>15</sup>

Computed tomography is sensitive in evaluating density of effusion and calcification<sup>15</sup> and differentiating malignancy from pericarditis by revealing solid nodules. While ECG-gated CT is useful for assessing the involvement of pericardial layers, epicardial fat, and myocardium, CMR is superior due to excellent tissue characterization and haemodynamic analysis and thus is the imaging technique of choice for myocardial and pericardial pathology.<sup>15,16</sup> Protocols include standard T1- and T2-weighted imaging with and without fat suppression and first-pass perfusion for vascularity; early and late Gadolinium phase assessment helps to define solid components, necrosis, adjacent thrombi and to differentiate healthy myocardium from tumorous infiltration and other pathology. Although cardiac DWI is not commonly performed in clinical practice due to motion artefacts, in our case, the excellent quality images showed diffusion restriction. Spin-echo sequences help to characterize pericardial effusion, especially septated or complex.<sup>15</sup> Diastolic septal flattening during deep inspiration is diagnostic for haemodynamic compromise in pericardial constriction. Phase-contrast velocity imaging is used to assess for



chamber or vessel obstruction by the tumour and can be applied to detect the expiratory diastolic caval flow reversal in pericardial constriction.<sup>17</sup> Volumetric module can accurately assess cardiac size and function particularly related to chemotherapy.

## Conclusion

Although malignant PPM is very rare, knowledge of imaging features helps to narrow the differential entities and to achieve a timely diagnosis, particularly in atypical appearances. Tissue sampling and histopathological analysis are crucial for the diagnosis and treatment planning.

## Lead author biography



Dr Audra Banišauskaitė is a final-year radiology trainee at Hospital of University of Health Sciences Kaunas Clinics. She graduated from Lithuanian University of Health Sciences in 2016. Audra is particularly interested in chest and cardiovascular imaging, presented at international congresses including European Congress of Radiology and is a co-author of an article

published in national scientific journal. She is also an active member of national and international radiology societies.

## Supplementary material

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

## Acknowledgements

The authors are grateful to Indrė Čėponienė MD, PhD and Jurgita Zaveckienė MD, PhD, for their contributions to this article.

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

**Consent:** The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

**Conflict of interest:** none declared.

## References

- Lam KY, Dickens P, Chan AC. Tumors of the heart. A 20-year experience with a review of 12,485 consecutive autopsies. *Arch Pathol Lab Med* 1993;**117**: 1027–1031.
- Restrepo CS, Vargas D, Ocazonez D, Martínez-Jiménez S, Betancourt Cuellar SL, Gutierrez FR. Primary pericardial tumors. *Radiographics* 2013;**33**:1613–1630.
- Gossinger HD, Siostrzonek P, Zangeneh M, Neuhold A, Herold C, Schmoliner R, Laczkovics A, Tscholakoff D, Mösslacher H. Magnetic resonance imaging findings in a patient with pericardial mesothelioma. *Am Heart J* 1988;**115**:1321–1322.
- Godar M, Liu J, Zhang P, Xia Y, Yuan Q. Primary pericardial mesothelioma: a rare entity. *Case Rep Oncol Med* 2013;**2013**:283601.
- Battifora H, McCaughey WTE, eds. *Atlas of Tumor Pathology (AFIP Series): Tumors of the Serosal Membranes, Fascicle 15, Third Series*. Washington, DC: Armed Forces Institute of Pathology, 1995.
- Mensi C, Romano A, Berti A, Dore R, Riboldi L. A second case of pericardial mesothelioma mimicking systemic lupus erythematosus in the literature in over 30 years: a case report. *J Med Case Rep* 2017;**11**:85.
- Sardar MR, Kuntz C, Patel T, Saeed W, Gnall E, Maizumi S, Lande L. Primary pericardial mesothelioma unique case and literature review. *Tex Heart Inst J* 2012;**39**:261–264.
- Mortimer AM, Rowlands J, Murphy P. Coarse pleural calcification in a mesothelioma patient raises the possibility of a rare tumour subtype: osteoblastic sarcomatoid mesothelioma. *Br J Radiol* 2011;**84**:e106–e108.
- Sbokos CG, Karayannacos PE, Kontaxis A, Kambylafkas J, Skalkeas GD. Traumatic hemopericardium and chronic constrictive pericarditis. *Ann Thorac Surg* 1977;**23**:225–229.
- Manhas AH, Martin RT, Reul GJ, Stainback RF. Heart failure due to a post-traumatic calcified pericardial hematoma. *Tex Heart Inst J* 2008;**35**:345–348.
- Basso C, Rizzo S, Valente M, Thiene G. Cardiac masses and tumours. *Heart* 2016;**102**:1230–1245.
- Adler Y, Charron P, Imazio M, Badano L, Barón-Esquívias G, Bogaert J, Brucato A, Gueret P, Klingel K, Lionis C, Maisch B, Mayosi B, Pavie A, Ristić AD, Sabaté Tenas M, Seferovic P, Swedberg K, Tomkowski W. 2015 ESC Guidelines for the diagnosis and management of pericardial diseases: the task force for the diagnosis and management of pericardial diseases of the European Society of Cardiology (ESC). *Eur Heart J* 2015;**36**:2921–2964.
- Rizzardi C, Barresi E, Brollo A, Cassetti P, Schneider M, Melato M. Primary pericardial mesothelioma in an asbestos-exposed patient with previous heart surgery. *Anticancer Res* 2010;**30**:1323–1325.
- Suman S, Schofield P, Large S. Primary pericardial mesothelioma presenting as pericardial constriction: a case report. *Heart* 2004;**90**:e4.
- Peebles CR, Shambrook JS, Harden SP. Pericardial disease—atomy and function. *Br J Radiol* 2011;**84** Spec No 3(Spec Iss 3):S324–S337.
- Pennell DJ, Sechtem UP, Higgins CB, Manning WJ, Pohost GM, Rademakers FE, van Rossum AC, Shaw LJ, Yucel EK. Clinical indications for cardiovascular magnetic resonance (CMR): consensus panel report. *Eur Heart J* 2004;**25**:1940–1965.
- Miller CA, Dormand H, Clark D, Jones M, Bishop P, Schmitt M. Comprehensive characterization of constrictive pericarditis using multiparametric CMR. *JACC Cardiovasc Imaging* 2011;**4**:917–920.