CASE REPORT

When is a mass not a mass? An unusual presentation of prominent crista terminalis

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SUMMARY

This case report describes a patient in whom echocardiography showed borderline left ventricular hypertrophy and a mass adjacent to the right atrial wall. This naturally caused some concern as the differential diagnoses included that of a right atrial myxoma and further investigations were organised. A subsequent cardiac MRI revealed this thickening to be a prominent crista terminalis. The crista terminalis is a variant of normal anatomical structures within the right atrium, which mimics an atrial mass.

BACKGROUND

The crista terminalis is a fibromuscular ridge formed by the junction of the sinus venosus and primitive right atrium.¹ It extends along the posterolateral aspect of the right atrial wall. Occasionally, this variant structure can become unusually prominent, consequently mimicking a right atrial mass.² We report a case of a prominent crista terminalis recognised and properly diagnosed by cardiac MRI (CMR).

CMR scanning allows the cardiologist to reliably confirm the presence or absence of suspected intracardiac masses and their structural relationships. The ability of CMR to 'tissue characterise' enables differentiation between neoplasm, thrombus, structural abnormalities and normal variant anatomical structures. An appreciation of the anatomy and MRI appearance of a prominent crista terminalis will minimise the misdiagnosis of this variant structure.

CASE PRESENTATION

A 32-year-old woman was referred to our clinic following a preoperative appointment for routine elective surgery. Her ECG performed at the time showed T-wave inversion in the anterior leads. She had suffered from palpitations over the previous 6 years. The first episode was during her pregnancy, at which point she was diagnosed with paroxysmal atrial fibrillation, confirmed by Holter monitoring. She was treated with propranolol 30 mg and aspirin. Apart from palpitations, she also had occasional episodes of dizziness, but no syncope. She reported neither of exertional chest pain nor shortness of breath.

She was a competitive athlete, running half marathons regularly and training on a weekly basis. She was a non-smoker and drank 20 units of alcohol per week. She had no other medical history of note. There was no family history of sudden death.

Clinically, the patient looked well, with a regular pulse and blood pressure of 130/60. Her jugular

venous pressure was not raised, but there was an ejection systolic murmur at the left sternal edge. The ECG showed sinus rhythm with left ventricular hypertrophy (figure 1). Interestingly, the ECG was also suggestive of right atrial enlargement with increased p-wave height (>2.5 mm) in the inferior leads.

Echocardiography showed borderline concentric left ventricular hypertrophy with increased flow across the aortic valve and a prominent mass-like structure in the right atrium, but no evidence of stenosis (figure 2). Holter monitoring showed sinus rhythm with no evidence of arrhythmias.

The initial impression was one of athlete's heart. A CMR was requested to rule out hypertrophic obstructive cardiomyopathy and to investigate further the prominent structure in the right atrium. The MRI scan revealed an increased left ventricular mass and band-like thickening in the right atrial wall.

Further sequences were performed to determine the nature of this mass. There was no evidence of perfusion on early gadolinium imaging. A series of images were taken in two orthogonal planes covering the whole of the atria. This confirmed that the mass was 'band-like' and located posterolaterally, extending superiorly, consistent with a crista terminalis (figures 3 and 4).

OUTCOME AND FOLLOW-UP

The patient was advised to stop taking aspirin in light of her diagnosis. She was followed up at cardiology outpatient before she was eventually discharged from cardiology care.

DISCUSSION

While in the majority of patients, a crista terminalis is a normal and benign finding, an association with atrial arrhythmias has been described. The crista terminalis can initiate ectopic atrial beats, particularly right atrial tachyarrhythmias.³ These may lead to paroxysmal atrial fibrillation or atrial flutter. It was estimated that two-thirds of focal right atrial tachycardias, in the absence of structural heart disease, arise from the crista terminalis.⁴

There are many right atrial structures that can mimic an abnormal mass. Meier *et al*⁵ reported that normal right atrial structures were identified using MRI in 59% of 149 healthy patients.⁶ These structures included the Eustachian valve, Thebesian valve, persistent sinus venosus, Chiari network and the crista terminalis.⁶ Most of these structures may not be shown well on routine standard views by transthoracic echocardiography. The course of

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Figure 1 Patient's ECG showing sinus rhythm with left ventricular hypertrophy.

regression resulting in adult crista terminalis is known to occur to variable degrees and is thus responsible for the widely variable prominence demonstrated by this structure.^{5 7}

Figure 5 shows an echocardiograph of a normal heart with both atria and ventricles. Figure 2 shows this patient's

Figure 2 Patient's echocardiograph, with a prominent structure in the right atrium (arrow). LA, left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.

echocardiograph, with borderline concentric left ventricular hypertrophy and a prominent structure in the right atrium.

In practice, each modality has its own strength and weakness. Transthoracic echocardiography is widely accessible and it helps reveal mass location, size, mobility and differentiation from extracardiac disease.⁸ Transthoracic echocardiography may show a mass in the right atrium for crista terminalis, as described in a case study by Akcay *et al.*⁹ Evaluation with echocardiography may be limited in patients with a large body habitus. Transoesophageal echocardiography gives better spatial resolution, but it is invasive and not as widely available. The diagnostic pitfall in determining masses in the right atria increases if echocardiography is used in isolation.¹⁰

In recent years, CMR has become the next modality of choice after echocardiography. The former renders higher soft-tissue resolution, allowing differentiation of, for instance, thrombus from cardiac tumours.¹¹ However, the patient's cooperation during the procedure is of importance, and contraindications

Figure 3 Early and late post gadolinium images confirming the presence of non-perfused structure in the right atrium (arrow).

Figure 4 A 'stack' of cines in the four-chamber plane demonstrating the anatomical relationships of the crista terminalis in the high right atrium.

such as claustrophobia, pacemaker or other metallic implants should be considered. Kim *et al*¹¹ described crista terminalis on MRI as the line of union between the right atrium and the right auricle on the interior of the atrium. Gaudio *et al*,⁷ in their case study, described the crista terminalis on CMR as having muscular ridges. Gadolinium contrast material is useful in differentiating a thrombus from a tumour, as the former does not show enhancement.

Multidetector CT scan is useful for assessment of calcification and fat content within a mass, and its high resolution is valuable to define small lesions.¹² Hoey *et al*¹² described crista terminalis as a band extending obliquely across the right ventricle on multidetector CT scan. However, risks from contrast use and radiation should be considered. CT and CMR both help visualise tissue characterisation well, with precise location; both can be used for detection of a right atrial mass or pseudomass.¹⁰ The choice of technique to use after echocardiography is still based on the discretion of the advising clinician.

In terms of clinical management, our patient was advised to stop aspirin in light of her diagnosis. According to the latest

Figure 5 Echocardiograph picture of normal heart.

National Institute for health and Clinical Excellence (NICE)¹³ guideline for the management of atrial fibrillation in 2014, aspirin monotherapy for stroke prophylaxis is no longer recommended. It is also further highlighted not to offer stroke prevention therapy to people under aged 65 years with atrial fibrillation and no risk factors other than their sex. This patient was at low risk of developing stroke, and had a CHA₂DS₂-VASC score of 1, therefore her aspirin was stopped. This case preceded the new guidance; however, in light of the new recommendation, it would still be reasonable to stop it.

Learning points

- An anatomical variant finding can mimic pathology. In this case, the association of prominent variant structure with arrhythmias is of clinical relevance.
- Cardiac MRI can differentiate between intracardiac mass, structural abnormalities and variant anatomical structures.

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REFERENCES

- 1 Salustri A, Bakir S, Sana A, *et al*. Prominent crista terminalis mimicking a right atrial mass: case report. *Cardiovasc Ultrasound* 2010;8:47.
- 2 Bolognesi M, Bolognesi D. A prominent crista terminalis associated with atrial septal aneurysm that mimics right atrial mass leading to atrial arrhythmias: a case report. *J Med Case Rep* 2012;6:403.
- 3 Kalman JM, Olgin JE, Karch MR, *et al*. Cristal tachycardias: origin of right atrial tachycardias from the crista terminalis identified by intracardiac echocardiography. *J Am Coll Cardiol* 1998;31:451e9.
- 4 Sanchez-Quintana D, Anderson RH, Cabrera JA, *et al*. The terminal crest: morphological features relevant to electrophysiology. *Heart* 2002;88:406e11.
- 5 Meier RA, Hartnell GG. MRI of right atrial pseudomass: is it really a diagnostic problem? *J Comput Assist Tomogr* 1994;18:398–401.
- 6 Ducharme A, Tardif JC, Mercier LA, *et al*. Remnants of the right valve of the sinus venosus presenting as a right atrial mass on transthoracic echocardiography. *Can J Cardiol* 1997;13:573e6.
- 7 Gaudio C, Di Michele S, Cera M, *et al*. Prominent crista terminalis mimicking a right atrial mixoma: cardiac magnetic resonance aspects. *Eur Rev Med Pharmacol Sci* 2004;8:165–8.
- 8 Auger D, Pressacco J, Marcotte F, *et al*. Cardiac masses: an integrative approach using echocardiography and other imaging modalities. *Heart* 2011;97:1101–9.
- 9 Akcay M, Bilen E, Bilge M, *et al*. Prominent crista terminalis: as an anatomic structure leading to atrial arrhythmias and mimicking right atrial mass. *J Am Soc Echocardiogr* 2007;20:197.e9–e10.
- 10 Mirowitz SA, Gutierrez FR. Fibromuscular elements of the right atrium: pseudomass at MR imaging. *Radiology* 1992;182:231–3.
- 11 Kim EY, Choe YH, Sung K, *et al*. Multidetector CT and MR imaging of cardiac tumors. *Korean J Radiol* 2009;10:164–75.
- 12 Hoey E, Ganeshan A, Nader K, *et al*. Cardiac neoplasms and pseudotumours: imaging findings on multidetector CT angiography. *Diagn Interv Radiol* 2012;18:67–77.
- 13 National Institute for health and Clinical Excellence. *NICE clinical guideline 180. Atrial fibrillation: the management of atrial fibrillation*. National Institute for health and Clinical Excellence, 2014.

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