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CASE REPORT
Other

Apical hypertrophic cardiomyopathy associated with circumflex to left ventricular fistulae: a case report of two rare subtypes of rare conditions occurring together

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Background Coronary arterial fistulae are rare yet have been associated with hypertrophic cardiomyopathy (HCM). We present a patient who was found to have a left circumflex (LCx) to left ventricular (LV) fistula in combination with apical HCM.

Case summary A 72-year-old female presented with syncope after exercise. She sustained facial injuries including fracture of her nasal bones. There were no previous episodes, no cardiac history, and she denied chest pain or anginal symptoms. Electrocardiogram showed sinus rhythm with T-wave inversion throughout the chest leads. Echocardiography suggested apical HCM with hypertrophy of the LV apex but good systolic function. This was confirmed on cardiac magnetic resonance imaging with a characteristically spade-shaped LV cavity. Coronary angiography demonstrated a distal LCx to LV fistula from the apical hypertrophy but no coronary artery disease. She was started on beta-blockers and has had no further episodes, remaining well.

Discussion Coronary fistulae are present in 0.002% of the population but clinical outcomes are poorly understood. The majority are asymptomatic but anginal chest pains can occur through the 'coronary steal' phenomenon. Apical HCM is a subtype of HCM characterized by spade-shaped LV cavity obliteration. It is unclear whether the association between fistulae and HCM occur because of the increased vascularization and fibrosis associated with HCM or whether congenital malformation leads to hypertrophy. Both can produce a constellation of cardiac symptoms. Our patient has the previously unreported combination of apical HCM and an LCx fistula; two rarer subtypes of rare conditions appearing together.

Keywords Apical • Hypertrophic • Cardiomyopathy • Circumflex • Fistula • Congenital • Case report

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Learning points

- Fistulae between the coronary arteries and the chambers of the heart or major vessels are rare (present in 0.002% of the population) and differ widely in their appearance and presentation, but often produce angina-like pain through the 'coronary steal' phenomenon.
- Apical hypertrophic cardiomyopathy (HCM) is a subtype of HCM characterized by spade-shaped left ventricular cavity obliteration and once considered benign, it is now known to have outcomes equivalent to other subtypes and is managed similarly.
- Hypertrophic cardiomyopathy and coronary artery-ventricular fistulae have a known association, but it remains unclear whether fistulae occur because of the increased vascularization and fibrosis associated with apical HCM or whether congenital fistula formation leads to hypertrophy.

Introduction

We describe a left circumflex (LCx) coronary artery to left ventricular (LV) fistula associated with apical hypertrophic cardiomyopathy (HCM) in a 72-year-old patient who presented with syncope. Coronary arterial fistulae are rare, yet have been associated with HCM. We outline of the common features of both and discuss the clinical relevance and pathophysiology of fistulae in the context of HCM.

Timeline

26 April 2017	Presented to emergency department after syncopal episode when walking to her car, after 30 min of water aerobics and a hot shower.
28 April 2017	Discharged by medical team after negative troponins and 48 h inpatient monitoring. Planned for outpatient echo and 24-h Holter monitor, with referral to cardiology.
Early May 2017	Echo suggestive of apical hypertrophic cardiomyopathy and negative 24 h tape.
26 May 2017	Cardiac magnetic resonance imaging confirming apical HCM with apical systolic cavity obliteration but no aneurysm, systolic anterior motion of the mitral valve or resting left ventricular outflow tract obstruction.
17 June 2017	Coronary angiography undertaken as outpatient showing left circumflex artery to left ventricular fistula but otherwise normal coronary arteries.
March 2019	No significant changes on further echo and repeat 24 h tape, and no further symptoms.
March 2020	Remains well at most recent follow-up appointment, with no further episodes of syncope or other symptoms.

Case presentation

A 72-year-old Caucasian female presented with syncope after 30 min of water aerobics. After having a hot shower and when walking to her car, she described momentary pre-syncopal symptoms before losing consciousness, rousing to passers-by assisting her seconds later. She felt well prior with no palpitations or chest pain. She sustained facial injuries including nasal bone fracture but no injury to the hands. There were no previous episodes and no cardiac history. Her medical history includes asthma, dyslipidaemia, and osteoporosis, all receiving satisfactory treatment. She is a non-smoker and does not drink alcohol. Her older brother (77 years) has a history of HCM and is well. She was admitted by the medical team for further assessment.

Examination was normal except for lacerations around her right eye and nose, with no murmurs or neurological lesions. Her blood pressure was 151/71 on arrival (but normalized after analgesia).

Electrocardiogram (ECG) showed sinus rhythm with T-wave inversion throughout the chest leads (deepest V3–V5) and inferiorly, with positive voltage criteria for left ventricular hypertrophy (*Figure 1*). Serial troponins were not significantly raised (initially 12 ng/L and 15 ng/L 4 h later, normal <15 ng/L) and no arrhythmias were seen on inpatient monitoring. Other investigations including routine bloods and chest X-ray were unremarkable. She was discharged after 48h (unfortunately before any further inpatient investigations were completed) and referred for outpatient cardiology assessment.

She underwent investigations a few weeks later following a cardiology outpatient appointment. Echocardiography suggested apical HCM, showing hypertrophy of the LV apex with apical wall thicknesses of 1.7–2.0 cm but good systolic function (*Video 1*). No LV pressure gradients were detected but tissue Doppler suggested diastolic dysfunction with raised LV filling pressures and severe left atrial (LA) dilation (90.5 mL). A 24-h ECG monitor showed normal sinus rhythm with no bradycardia or arrhythmias.

Cardiac magnetic resonance imaging (MRI) (1-month post-presentation) confirmed the diagnosis of apical HCM (*Video 2*). She had a small, characteristically spade-shaped LV cavity (*Figure 2*) with a maximum wall thickness of 14 mm circumferentially at the apex (9 mm at basal-septal level). There was a supra-normal ejection fraction and 22 mm apical systolic cavity obliteration (*Figure 3*). Papillary muscles were displaced but there was no systolic anterior motion of the mitral valve or LV outflow tract obstruction. The right ventricle and atrium had normal structure and function and the LA was mildly dilated (27 cm^2). There was no late gadolinium enhancement and

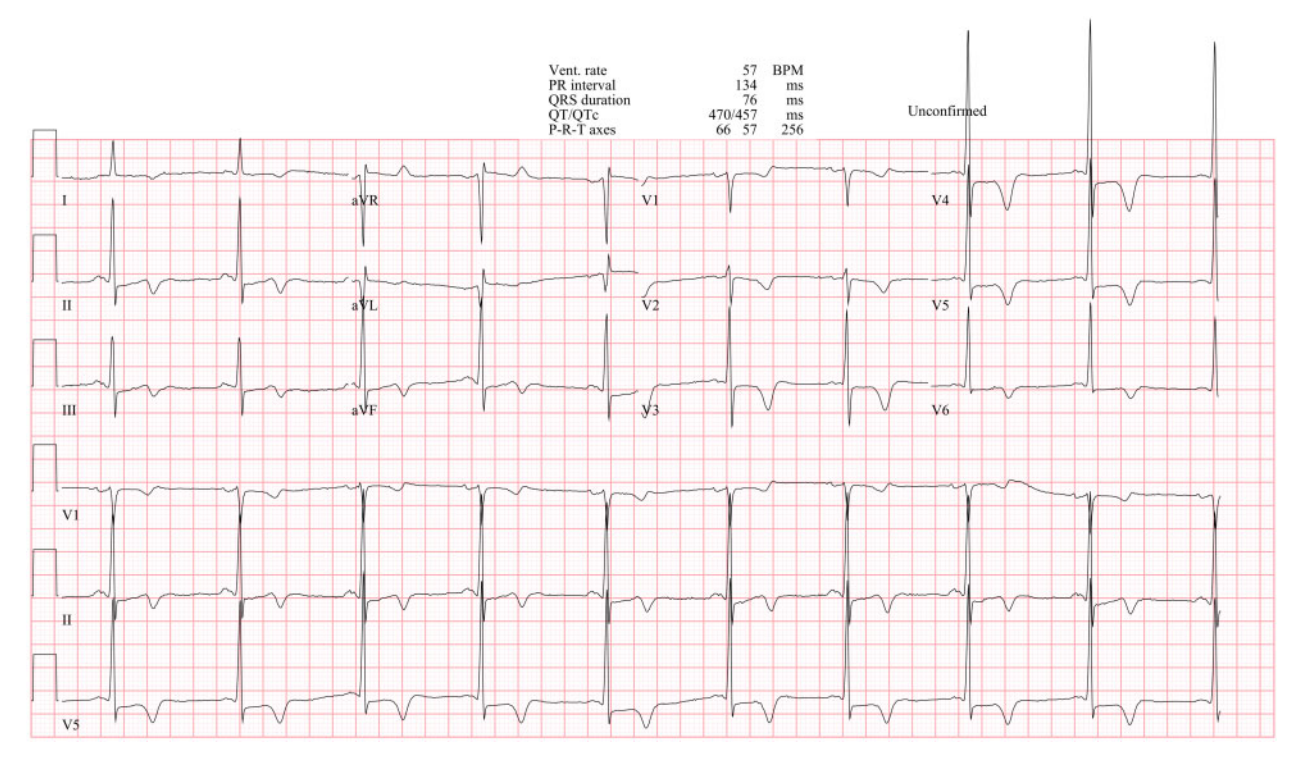
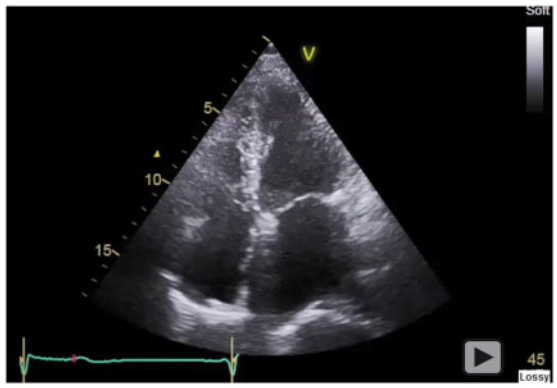


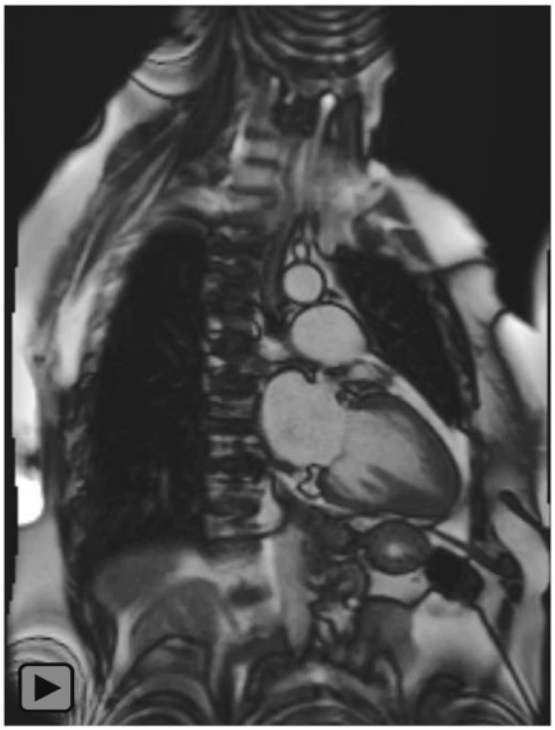
Figure 1 Electrocardiogram from initial cardiology appointment. Note the deep T-wave inversion visible throughout the chest leads with further TWI inferiorly.



Video 1 Transthoracic echocardiogram loops. Apical four-chamber, left ventricular-focused four-chamber, and three-chamber views show the apical thickening of the left ventricle with preservation of systolic function.

valves were normal. There was an inducible perfusion defect in the apex.

Coronary angiography was undertaken 3 weeks later to assess inducible ischaemia seen on MRI. This demonstrated unobstructed coronary arteries but a stream of contrast into the left ventricle from the apex (*Video 3*). This distal LCx to LV fistula emerged from a bed of increased vascularity, corresponding to the apical hypertrophy. The interpretation of the perfusion defect



Video 2 Cardiac magnetic resonance cine videos in two-chamber, three-chamber, and four-chamber views confirming the diagnosis and highlighting the left ventricular cavity obliteration.

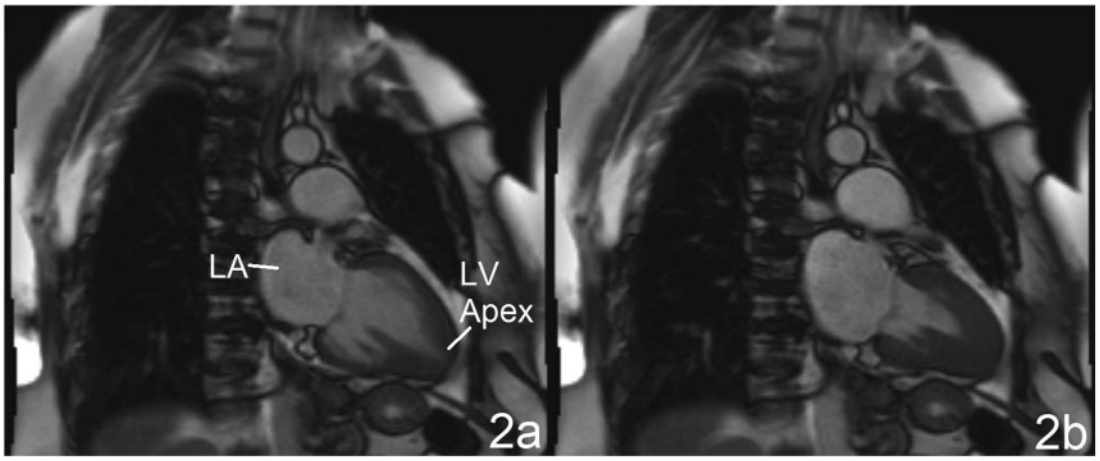


Figure 2 Cardiac magnetic resonance imaging cine two-chamber views in diastole (*A*) and systole (*B*) with where the apical hypertrophy clearly contrasts with the normal wall thickness seen throughout the rest of the left ventricle. Also note the left atrial enlargement.

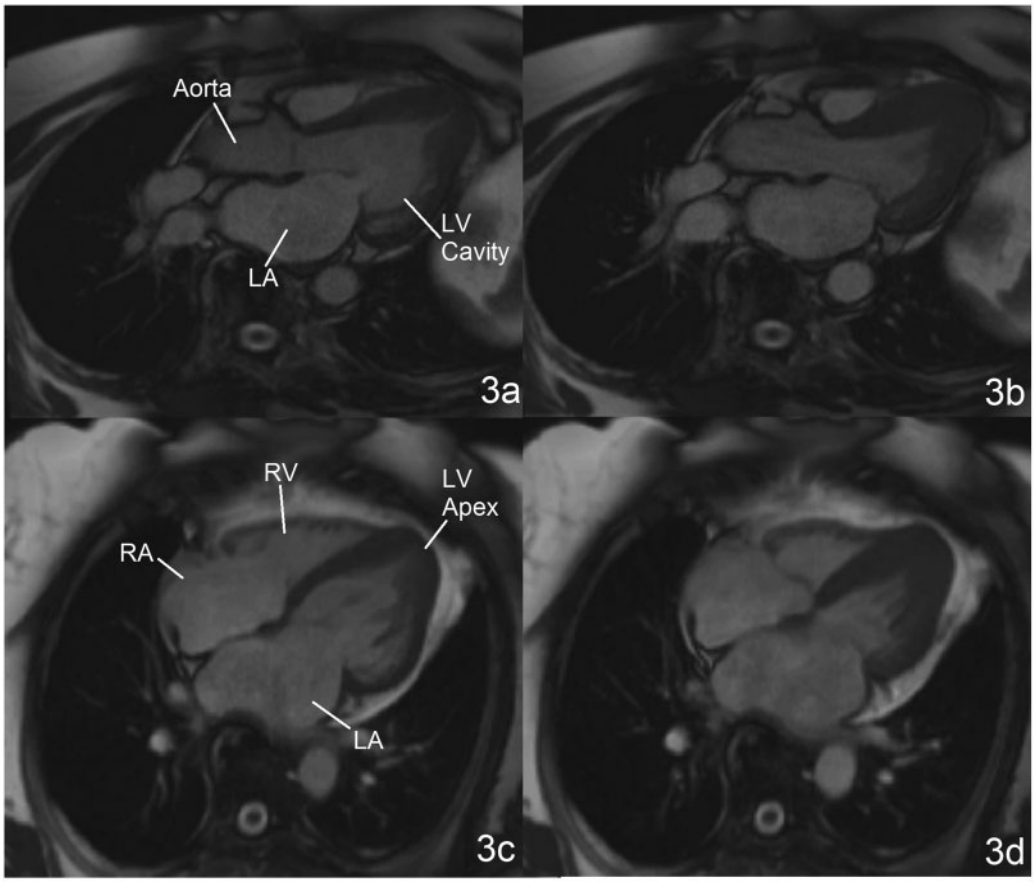
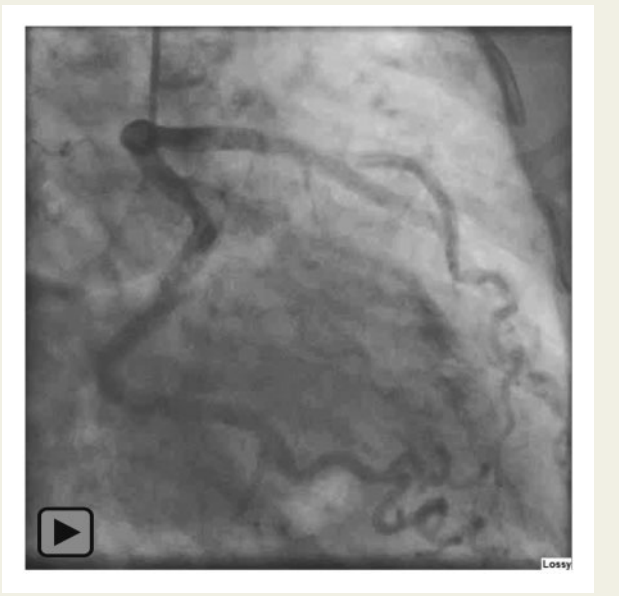


Figure 3 Cardiac magnetic resonance imaging cine three-chamber (*A* and *B*) and four-chamber views (*C* and *D*). Obliteration of the left ventricular cavity during systole (*B* and *D*) is demonstrated with the 'spade shape' appearance of the left ventricular cavity typical of the condition in diastole (*A* and *C*).



Video 3 Left coronary angiogram (right anterior oblique (RAO)-10 projection then RAO caudal projection) clearly showing contrast entering the ventricle from the left circumflex. Final clip is the right coronary angiogram in left anterior oblique (LAO) caudal projection, with no right coronary artery (RCA) fistulae identified.

seen was microvascular dysfunction in the context of apical hypertrophy.

The European Society of Cardiology (ESC) HCM risk calculator indicated a 5-year risk of sudden cardiac death of 3.92% such that an implantable cardioverter-defibrillator (ICD) was not indicated. The patient was commenced on treatment with bisoprolol (2.5 mg once daily).

Discussion

Hypertrophic cardiomyopathy is the most common heritable cardiomyopathy, presenting as asymmetrical LV hypertrophy without secondary cause.[1] Genetic mutations (frequently encoding sarcomeric proteins) underlie the pathology[2] but a broad range of affected genes produce a phenotypically diverse condition with several subtypes categorized by the anatomical region affected. It can be suggested by ECG changes including deep T-wave inversion and positive LV hypertrophy voltage criteria and confirmed with echocardiography and cardiac MRI. Our patient presented with such ECG abnormalities and although these features are not deemed 'high-risk' in themselves,[3] ESC syncope guidelines recommend further inpatient investigation when combined with a brief (or no) prodromal period prior to collapse.[3] Inpatient echocardiography would have provided the initial diagnosis of apical HCM before discharge.

Apical HCM is a subtype (3% of HCM in the USA, but 15% in Japan where first described[4]) characterized by a spade-shaped LV cavity with apical systolic obliteration and sometimes aneurysm formation. Once considered benign it is now known to have outcomes equivalent to other subtypes.[1] It has been misdiagnosed as other pathologies including LV thrombus, tumours, or non-compaction cardiomyopathy. Hypertrophic cardiomyopathies produce symptoms from arrhythmias (including atrial fibrillation), heart failure, syncope/presyncope, and chest pain to sudden cardiac death but many patients are asymptomatic. Management is through family/genetic screening, symptom alleviation (through lifestyle modification, pharmacological, or interventional strategies), and risk stratification for sudden death (with ICD insertion in high-risk individuals).[1,2]

Fistulae between the coronary arteries and the heart chambers or major vessels are present in 0.002%[5] of the population and up to 0.2% of patients undergoing cardiac catheterization[6] but differ widely in their appearance and presentation.[7] Most are congenital (and up to 20% have other congenital malformations[6]) but acquired causes exist including iatrogenic, traumatic, and disease-related. They most commonly affect the right coronary or left anterior descending arteries, with the circumflex being the least common. 5% of patients have involvement of two arteries or more.[6]

Long-term outcomes are poorly understood.[8] Although the vast majority are asymptomatic, the most common symptom is anginal chest pain through the 'coronary steal' phenomenon in patients who have no/minimal coronary artery disease. Ischaemia is produced in areas of myocardium distal to the fistula origin as blood is shunted in diastole to the lower-pressure LV cavity from the coronary arteries via the low resistance tract. Other manifestations include thrombosis, embolism, cardiac failure, atrial fibrillation, rupture, endocarditis/endarteritis, and arrhythmia.[9]

Management is mostly conservative with anti-anginal agents to control symptoms (usually beta-blockade/nicorandil), lessening the demand-supply imbalance by reducing oxygen demand. If signs of failure, significant left-to-right shunt or other coronary/cardiac lesions then surgical closure can be successful[10] but was not indicated here. Catheter-based treatments using coils for embolization are also available with varying degrees of success.[11]

There is an association between coronary fistulae and hypertrophic cardiomyopathies.[12] Most cases are found during investigations for angina where first-line investigations of echocardiography and coronary angiography find both conditions concurrently. The reduced oxygen supply due to coronary steal and the increased oxygen requirements of the hypertrophic myocardial tissue may exacerbate ischaemia. There are, however, no reported cases of myocardial infarction due to the combination. A number of cases specifically show an association with apical HCM[13,14] yet no cases appear to show a fistula to the LV arising from the LCx artery.[15]

It remains unclear whether fistulae occur because of the increased vascularization and fibrosis associated with HCM or whether congenital malformation leads to hypertrophy as a compensatory response to chronic volume overload caused by the shunt between artery and ventricle. Conversely, microfistulae may be produced due to disarray of myocardial cells and abnormal vascularity supplying the areas of hypertrophy.

Hypertrophic cardiomyopathy and coronary artery-ventricular fistulae are rare conditions with a known association. Both produce a constellation of cardiac symptoms including chest pain. Our case is of interest due to the previously unreported combination of apical HCM and an LCx artery fistula; two rarer subtypes of rare conditions

occurring together. Our patient denied prior symptoms and the abnormalities were unexpected findings after an episode of syncope. Her risk has been deemed low and she has had no requirement for an ICD. She remains well on medical therapy and has experienced no further syncope 3 years after her initial presentation. She continues to be followed up in clinic with annual echocardiography.

Lead author biography

Dr Samuel Conway is Senior Clinical Fellow in Heart Failure at the Royal Free Hospital. He graduated from UCL Medical School in 2015 and has continued his training in hospitals across London. He has previously held cardiology posts at the Hammersmith Hospital and the Royal London Hospital.

Supplementary material

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

Slide sets: A fully edited slide set detailing this case 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 guidelines.

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