Paradoxical coronary artery embolisation: an unusual cause of myocardial infarction

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Introduction

A patent foramen ovale is associated with an increased risk of ischaemic cerebrovascular accidents secondary to thromboembolic phenomena. Less commonly, a patent foramen ovale may be a source of paradoxical coronary embolism, resulting in a myocardial infarction. This article describes a case in which a patient presented with a non-ST segment myocardial infarction secondary to paradoxical coronary embolisation. The case outlines the clinical picture and the investigations that enabled diagnosis of a patent foramen ovale in the context of a myocardial infarction, as well as the subsequent management of the patient.

Case report

A previously healthy 27-year-old man presented to the emergency department with central compressive chest pain that had woken him up from his sleep. There were no associated features such as shortness of breath, palpitations or diaphoresis. He was haemodynamically stable, the electrocardiogram showed normal sinus rhythm and the chest X-ray was unremarkable. An initial mildly elevated troponin T level was noted (27 ng/litre, normal range 3–14 ng/litre). A bedside echocardiogram revealed normal left ventricular ejection fraction, no regional wall motion abnormalities and no valvular pathology. A repeat troponin T level, performed after 6 and 12 hours, and then daily, showed a substantial rise from 27 ng/litre to 182 ng/litre; all other blood investigations were within normal limits.

Serial measurements of troponin T levels were taken, with the value peaking at 818 ng/litre, and then slowly trending downwards. Urgent cardiac magnetic resonance imaging showed mid-left ventricular inferior and inferolateral akinesia with corresponding transmural late gadolinium enhancement and oedema with a prominent central core of microvascular obstruction (Figure 1). The patient was started on treatment for acute coronary syndrome and transferred straight to the cardiac catheterisation laboratory. A coronary angiogram was performed which revealed a right dominant system without any intraluminal vessel stenosis.

The patient was thought to have a myocardial infarction with non-obstructive coronary arteries. Since recovery was uneventful, the patient was discharged on dual antiplatelets and an angiotensin-converting enzyme inhibitor with a view to performing a transthoracic echocardiogram bubble study (contrast echocardiogram) within 2 weeks (Figure 2). This showed a large patent foramen ovale after agitated saline was injected via the right cubital vein. A right to left shunt was confirmed as bubbles were noted to pass from the right to the left on cough and vagal manoeuvres. In the meantime, a thrombophilia and vasculitic screen was taken to exclude the presence of inherited thrombophilias or systemic vasculitis. A whole body fluorodeoxyglucose-positron emission tomography scan was also performed. Results of these tests were normal.

These findings point towards paradoxical coronary embolisation as the cause of myocardial infarction, with a patent foramen ovale being the source. The cause of embolisation remains unknown as no thrombogenic focus was identified in the lower limbs or elsewhere.

The patient was referred to the structural cardiologists for percutaneous closure of the patent foramen ovale, which was carried out without any complications. Dual antiplatelet therapy was continued for 6 months. Repeat cardiac magnetic resonance after 6 months showed mildly impaired global left ventricular systolic function, and a thin and akinetic mid-ventricular inferolateral wall in keeping with a corresponding infarct affecting 50% of the transmural thickness (Figure 3).

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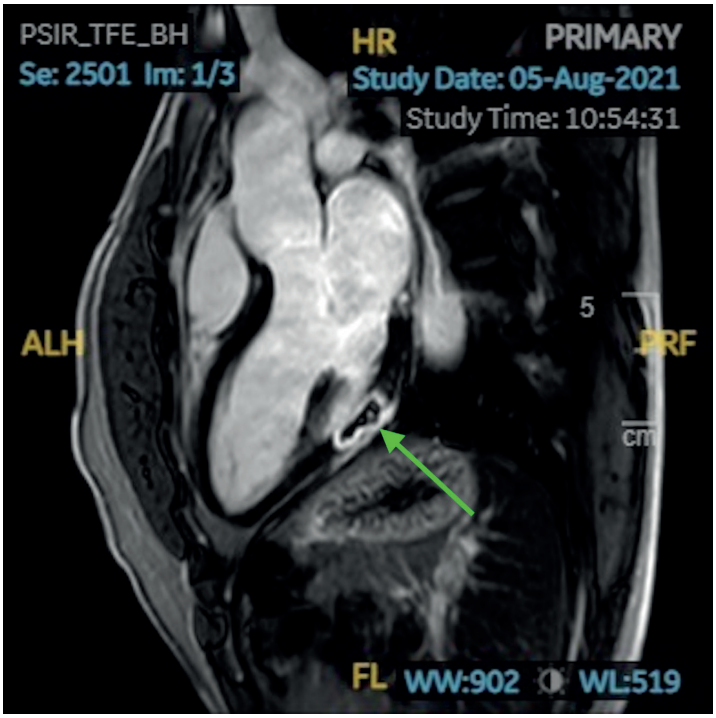

Figure 1. Cardiac magnetic resonance imaging showing evidence of microvascular obstruction.

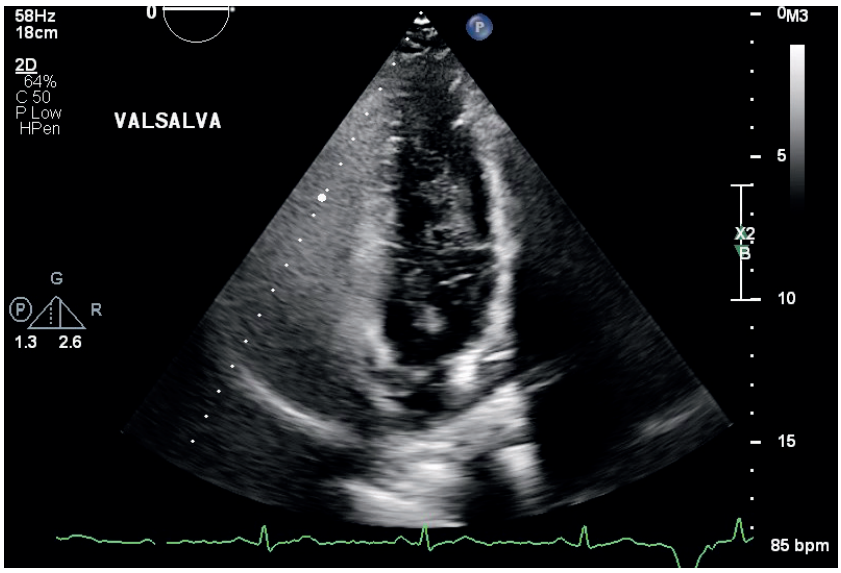

Figure 2. Contrast echocardiogram showing passage of bubbles through the inter-atrial septum.

Discussion

Coronary artery embolisation is an important non-atherosclerotic cause of myocardial infarction. It may be iatrogenic, direct or paradoxical in nature (Raphael et al, 2018). Iatrogenic embolisation is most commonly associated with interventional procedures on the heart, such as percutaneous coronary intervention, especially when rotablation is performed (Waksman et al, 1996). Direct coronary embolism occurs secondary to thrombus formation within the heart, with the left atrial appendage being a major culprit (Shibata et al, 2015). Paradoxical coronary embolisation is the least common of the three with the exact incidence unknown, although data suggest that it may be under-reported. The cause is usually a patent foramen ovale or atrial septal defect, which results in an embolus entering the left side of the heart directly from the right, and subsequently the coronary arteries through the sinus

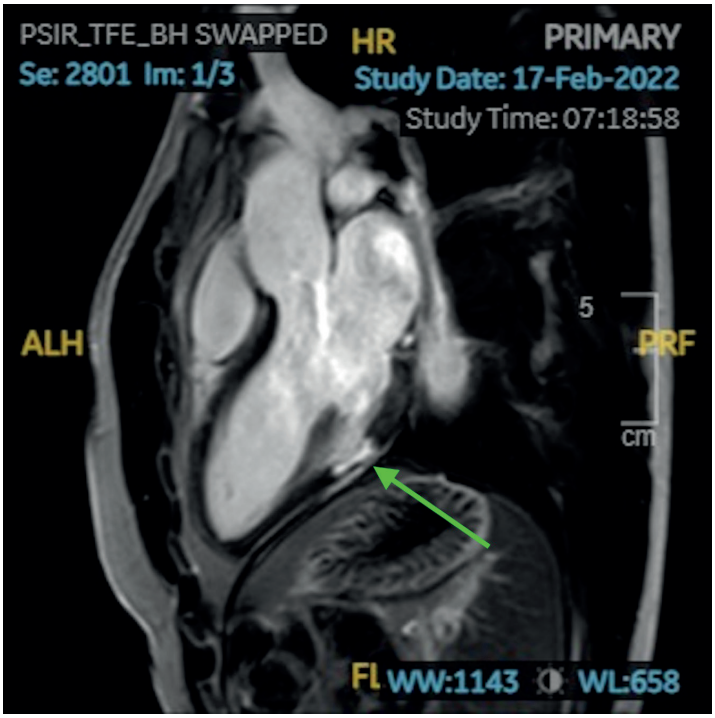

Figure 3. Repeat cardiac resonance imaging showing evidence of a residual scar (arrow).

of Valsalva. The source of the embolus is not always identified, but possible causes include thrombotic events in the peripheral venous circulation (Hakim et al, 2014).

The use of echocardiography with contrast is crucial in cases of cryptogenic myocardial infarction, especially if a shunt is suspected (Choi et al, 2021). Moreover, the role of cardiac magnetic resonance is increasingly being explored. A major criterion for diagnosis of coronary embolisation is the detection of a coronary embolus or thrombus using coronary angiography (Shibata et al, 2015). This was not present in this case; as the rise in troponin levels was not very high, it is probable that the coronary embolus was quite small. Nonetheless, cardiac magnetic resonance still showed evidence of microvascular obstruction with corresponding regional wall motion abnormalities. It is increasingly suggested that cardiac magnetic resonance should be included in new scoring systems as it can provide important additional information, even when coronary angiography is normal (Chongprasertpon and David, 2020).

Despite paradoxical embolisation events resulting in a myocardial infarction being rare, percutaneous closure of a patent foramen ovale in a patient with myocardial infarction with non-obstructive coronary arteries should strongly be considered as this is probably superior to medical therapy. The same principle applies in cases of a stroke (Carroll et al, 2013).

Learning points

- Myocardial infarction may not necessarily occur as a result of coronary artery disease; the possibility of myocardial infarction with non-obstructive coronary arteries should be kept in mind when coronary angiography does not show a significant lesion.
- Although not common, coronary artery embolisation is an important cause of myocardial infarction with non-obstructive coronary arteries, and may lead to significant morbidity and mortality. An important cause is a patent foramen ovale, which may cause paradoxical embolisation. This should be especially considered in young patients without any cardiovascular risk factors that present with a myocardial infarction, whether ST elevation or non-ST elevation.
- Cardiac magnetic resonance imaging and contrast echocardiography are useful investigations in these cases; as well as their diagnostic role, they can also guide further investigations and treatment options.

Conclusions

This case highlights the importance of having a low threshold for the possibility of paradoxical cardiac embolisation in young, healthy patients with no coronary artery stenosis detected on coronary angiography. Further imaging such as cardiac magnetic resonance and contrast echocardiography should be used in such cases.

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