

Serial Cardiac Magnetic Resonance of an evolving subacute pericardial hematoma

Running title: Cardiac Magnetic Resonance of Pericardial Hematoma

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Patient history

The patient presented is a 77-year-old man. His cardiovascular history is significant for non-ST elevation myocardial infarction (NSTEMI) followed by three-vessel coronary artery bypass grafting (left internal mammary artery to left anterior descending, saphenous vein grafts to obtuse marginal and posterior descending arteries) in 2016 and an abdominal aortic aneurysm under surveillance. He underwent total colectomy and ileostomy for diverticulitis in 1996 and suffered aplastic anaemia with a platelet count in the range 30–60 $\times 10^9/L$.

He presented to the acute medical service following a collapse. He lost consciousness, falling forwards and hitting his chest on a hard surface. On admission, his blood pressure was 119/68 mmHg lying and 89/58 mmHg standing. He was diagnosed with postural hypotension owing to dehydration from a high stoma output and was discharged after a period of observation. A systolic murmur had been noted and arrangements were made to investigate this with outpatient echocardiography.

Initial cardiovascular magnetic resonance (CMR)

His echocardiogram revealed a large pericardial collection without tamponade and normal biventricular function. He was admitted and a CMR was performed to rule out cardiac perforation.

CMR images were acquired on a Siemens Avanto Fit 1.5T clinical system. Long and short axis cine images are shown in figure 1 and supplemental movies 1 and 2. This revealed a large mass measuring 55x80mm adjacent to the lateral border of the left ventricle (LV) with a smooth margin, with significant compression and deformation of the LV lateral wall and rightward displacement of the LV within the pericardial sac. LV and RV volumes and ejection fractions were normal.

On T1- and T2-weighted images (figure 2), the mass showed heterogeneous signal intensity, and appeared isointense to the myocardium, which did not attenuate on fat-suppression imaging.

Native T1- and T2-mapping (figure 3) showed the mass to be heterogeneous. The mass had pockets of significantly elevated T1 and T2 values (T1 up to 1270 ms and T2 up to 76 ms), suggestive of fluid within the mass. Overall average T1 was 945 ms and T2 53 ms (normal ShMOLLI myocardial T1 range 941 ± 23 ms and normal myocardial T2 range 48 ± 2 ms at 1.5 Tesla in our centre).

The mass did not enhance on rest perfusion imaging (movie 3), and appeared mostly avascular on late gadolinium imaging (figure 4), excepting small areas of enhancement seen on short axis images, which appeared to correlate with the course of the obtuse marginal bypass graft.

Tissue characteristics of the mass were most likely to represent organised thrombus mixed with pericardial fluid and blood within the pericardial space, with mass effect and diastolic compression of the LV lateral wall. The mass was contained laterally, owing to adhesions within the pericardium

from prior surgery. The differential diagnosis included a neoplastic lesion; however, this was felt less likely, owing to the smooth edges of the mass, containment within tissue boundaries, and the absence of a significant vascular component on perfusion imaging.

Re-sternotomy and exploration of the pericardium was judged to be too high-risk owing to his thrombocytopenia and the course of a bypass graft within the mass. As the patient remained asymptomatic, an active monitoring strategy with serial imaging was followed.

Follow-up images

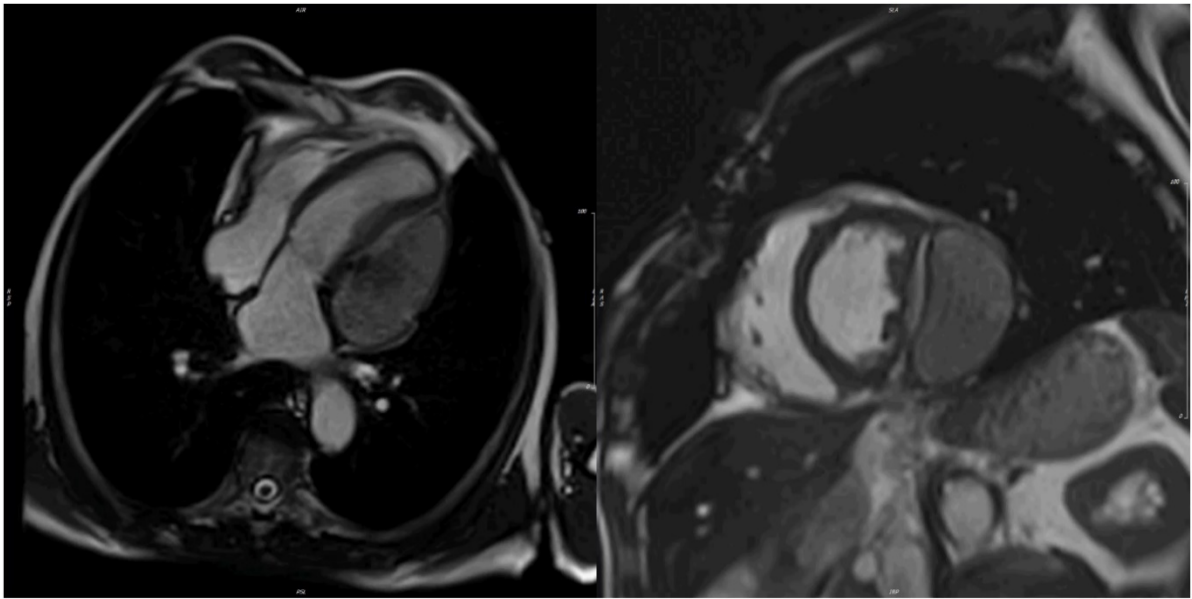
Figure 5 shows changes in the mass over the subsequent four months. Although there was little change in size, there was a detectable change in the signal characteristics, with areas of low T1 spreading across the mass but the pockets of high T2 (up to 109ms) continuing to expand (see table 1).

Discussion

This is the first report showing dynamic tissue changes within a traumatic hemopericardium using serial multiparametric CMR in the same individual. Hemopericardium has been described following trauma, in some cases detected as a late event following a progression to constrictive pericarditis and subsequent heart failure (Chamsi-Pasha et al., 2010), however this is the first report of serial imaging changes as a hemopericardium has matured. MR signal characteristics of hematoma vary with time, as hemoglobin is transformed into methemoglobin and hemosiderin, and as fibrinous strands form within the hematoma (Lombardi et al., 2018). Compared to simple pericardial fluid, hemo-pericardium is characterised by a heterogeneous high signal intensity on T1-weighted MR imaging (Seelos, Funari, Chang, & Higgins, 1992), and, owing to iron content, may result in areas with a lower signal intensity on T2-weighted images, T2 mapping, and native T1 mapping. Subacute (1-4 weeks) hematoma show heterogeneous signal intensity, with areas of high signal owing to pockets of fluid (Lombardi et al., 2018). Over the ensuing 4 months, we observed a general decrease in average T1 (perhaps representing persisting iron) but a general increase in average T2 values, with increased heterogeneity within the hematoma as it organised. Chronic hematomas have a thick rim from hemosiderin deposition and internal foci of varying intensity from calcification, fibrosis or hemosiderin deposition. Hematomas will uniformly fail to enhance on the administration of Gadolinium-based contrast agents, owing to their avascular nature.

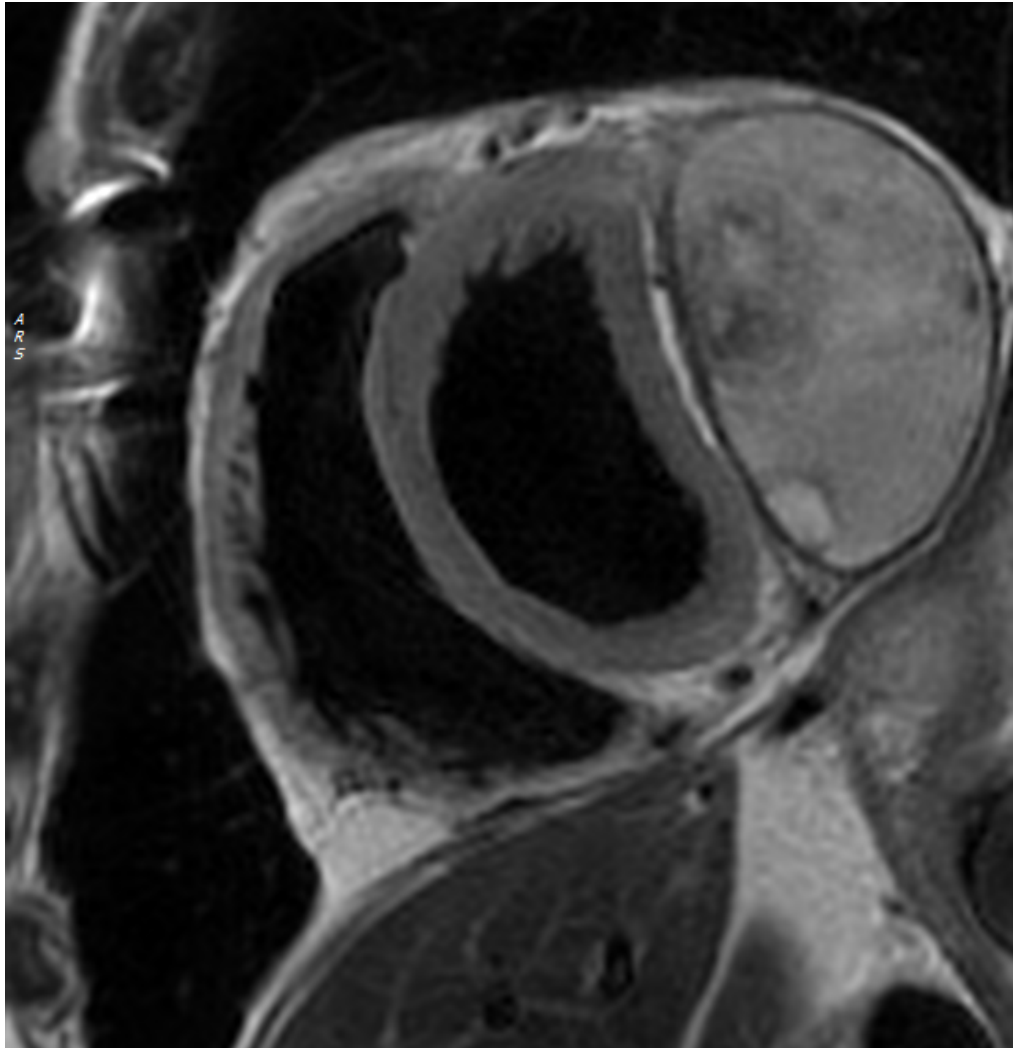
In this case, the ability to characterise this mass using non-invasive, multiparametric tissue characterisation on CMR saved the patient from undergoing invasive procedures and allowed conservative management. At 9 months post presentation, he remains well.

Figure 1



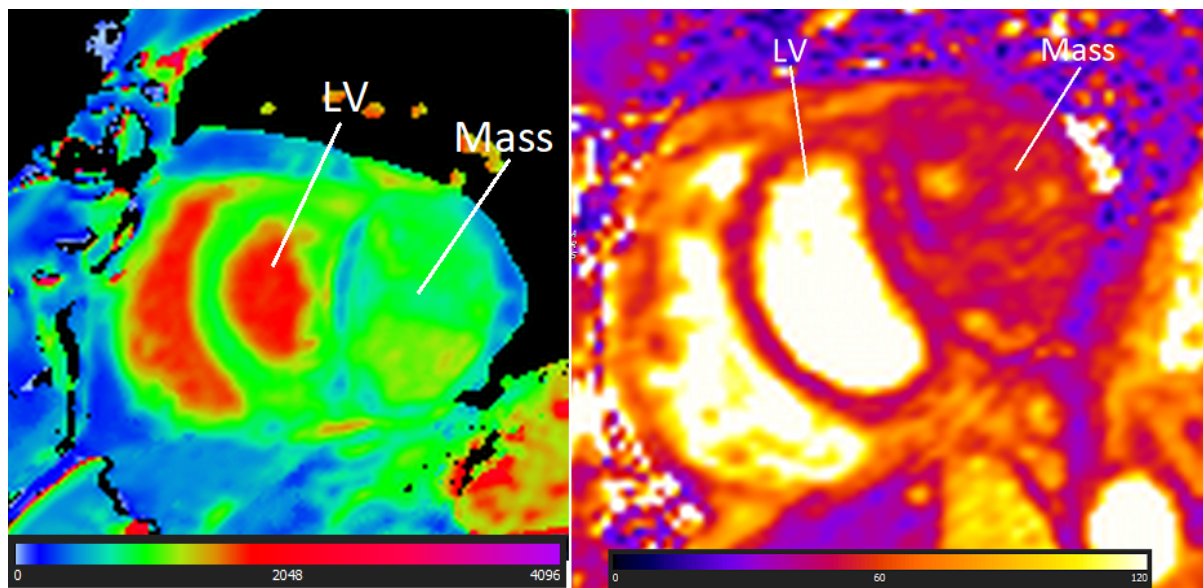
Horizontal long-axis (HLA) and short axis (SA) images, stills taken from cine. The mass is clearly shown on the lateral aspect of the left ventricle.

Figure 2



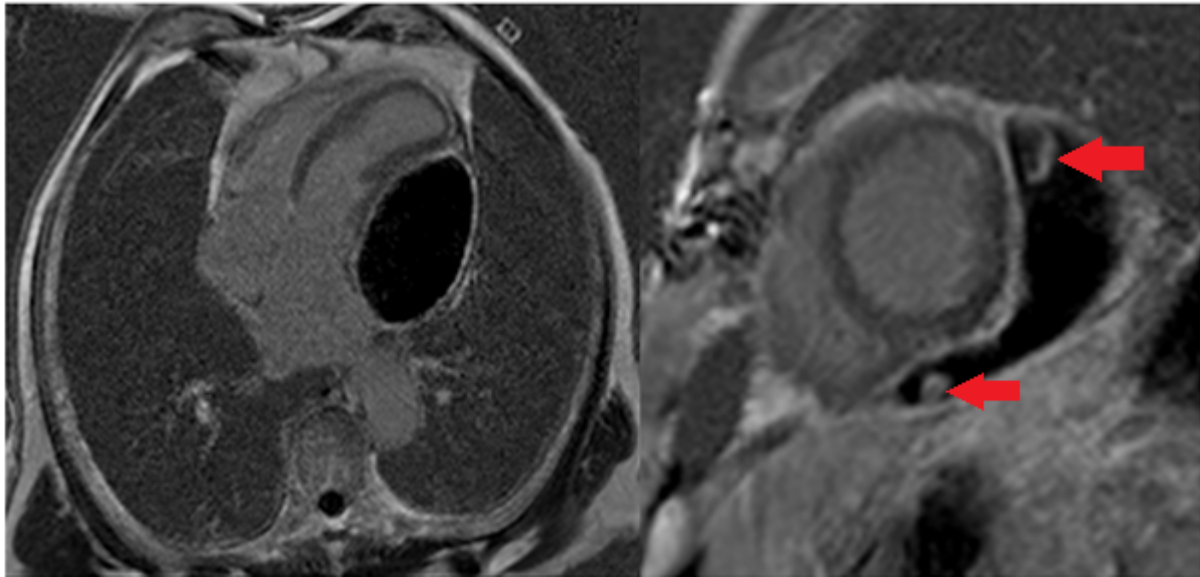
T2 BLADE (Siemens proprietary name for periodically rotated overlapping parallel lines with enhanced reconstruction sequence) short axis image demonstrating the heterogenous nature of the collection.

Figure 3



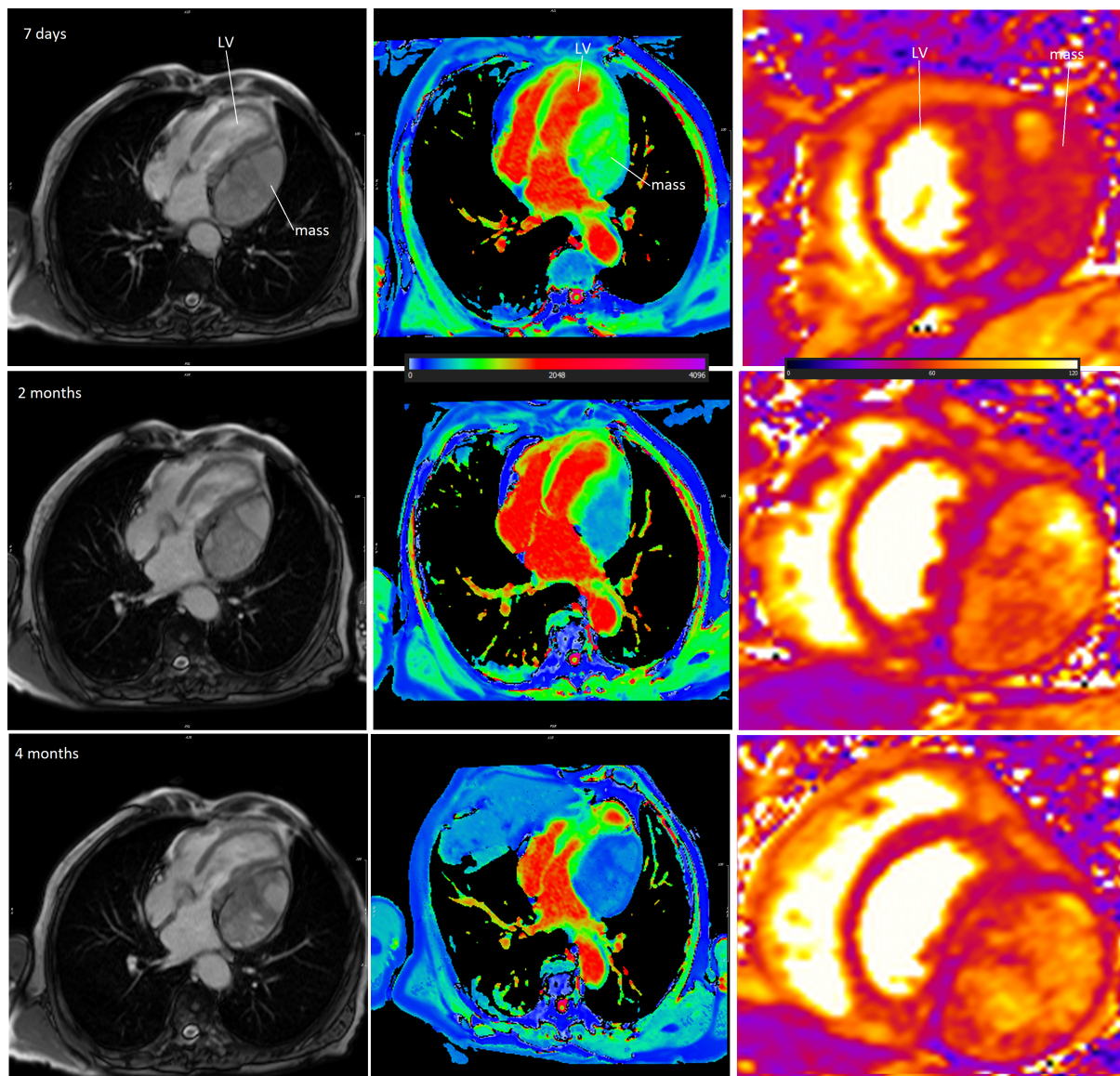
Native T1 (ShMOLLI sequence) and T2 maps. A numerical reference scale is displayed for the T1 and T2 values corresponding to the colours in the image.

Figure 4



Late Gadolinium imaging in horizontal long axis and short axis views. Note the enhancing structures within the anterior and inferior corners of the mass, thought to represent a bypass graft.

Figure 5



Scans at 7 days (top row), 2 months (middle row) and 4 months (lower row), demonstrating change in heterogeneity and signal characteristics over time. The left column shows an HLA scout image, the middle column shows HLA T1 map and the right column shows short axis T2.

Table 1

| Time point | | Presentation | 7 days | 2 months | 4 months |
|------------|---------|--------------|--------|----------|----------|
| T1 | Average | 971 | 836 | 471 | 395 |
| | Maximum | 1274 | 1597 | 765 | 559 |
| | Minimum | 673 | 309 | 258 | 293 |
| T2 | Average | 54 | 55 | 71 | 72 |
| | Maximum | 96 | 99 | 134 | 109 |
| | Minimum | 30 | 38 | 37 | 46 |

Signal characteristic changes over time.

References

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Disclosures

None

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None