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Photos In Pediatrics

# Visualizing high-intensity thrombosis with plaque imaging of coronary aneurysm in Kawasaki disease

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Kawasaki disease (KD) is an acute febrile disease that occurs mainly in infants. The pathophysiology of KD is vasculitis of primarily medium-sized vessels. The coronary arteries are particularly susceptible to damage in KD; if a coronary aneurysm occurs, long-term follow-up and repeated examinations are imperative. Coronary artery lesions associated with KD are evaluated using various modalities. As many tests impose high invasiveness, radiation exposure, and the use of contrast media, both patients and doctors tend to hesitate to repeat the examinations. Cardiovascular magnetic resonance (CMR) imaging enables visualization of the coronary arteries by magnetic resonance coronary angiography (MRCA) and does not employ radiation exposure or contrast media. Furthermore, including T1-weighted images (T1WI)allows the properties of wall thrombus and plaques to be evaluated.

The patient is a 15-year-old woman who suffered from KD at the age of 7 and had a giant aneurysm involving both coronary arteries. Coronary artery bypass surgery had been performed between the left internal thoracic artery and the left anterior descending branch 5 years previously due to severe stenosis in the distal part of the left coronary artery aneurysm. Multiple aneurysms were identified in the right coronary artery (RCA) (Fig. 1). Coronary artery lesions were followed up regularly using coronary computed tomography angiography (CCTA) and CMR. The patient reported no problems with daily exertion or regular exercise and electrocardiograms showed no abnormalities. Non-contrast MRCA was performed to evaluate a suspected wall thrombus in the RCA aneurysm that was detected by CCTA performed immediately prior (Fig. 2a) . Although the MRCA showed no progression of vascular lumen stenosis, the wall thrombus was depicted unclearly (Fig. 2b) and subsequent plaque imaging (PI) revealed marked hyperintensity of the wall thrombus (Fig. 2c). A fusion image of MRCA and PI showed matching of the high-signal intensity thrombus on the PI with the irregular wall seen on MRCA (Fig. 2d). The MRCA confirmed a thrombus in the giant RCA aneurysm. As the patient has reported no symptoms indicative of ischemia, she has received outpatient follow up and continued anticoagulant therapy.

In this case, the combination of MRCA and PI was able to detect the wall thrombus in the aneurysm. Magnetic resonance coronary angiography (MRCA) is an essential tool in detecting coronary artery lesions (e.g., stenosis and aneurysm) in pediatric KD.[1,2] Although conventional MRCA is excellent for evaluating the vessel lumen, it is challenging to depict a wall thrombus using non-contrast MRCA. In non-contrast MRCA, the blood flow signal is high, whereas wall thrombus and

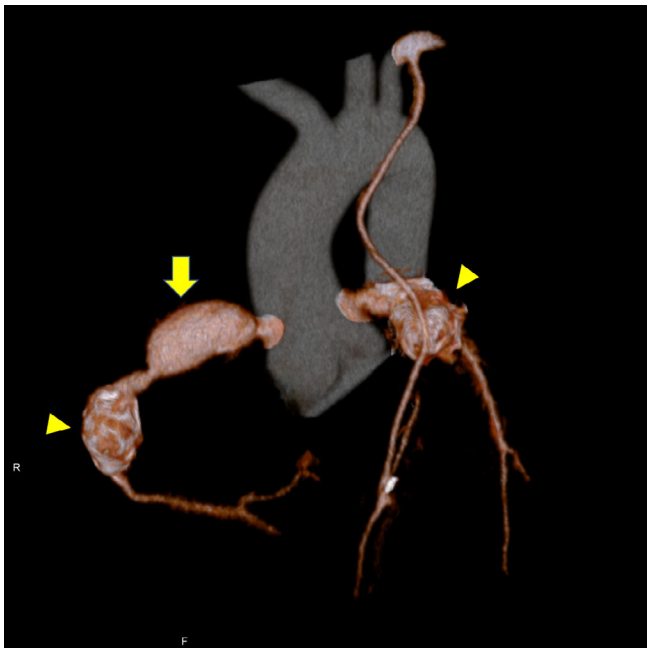


**Fig. 1** Coronary computed tomography angiography (3D image) showed coronary artery bypass graft between the LITA and the LAD. Multiple aneurysms were identified in the coronary arteries. The surface of aneurysm in the LAD and RCA were irregular (yellow arrowhead), and the wall thrombus were suspected. In contrast, the surface of aneurysm in the proximal RCA was smooth (yellow arrow). CCTA, coronary computed tomography angiography; LITA, left internal thoracic artery; LAD, left anterior descending branch; RCA, right coronary artery.

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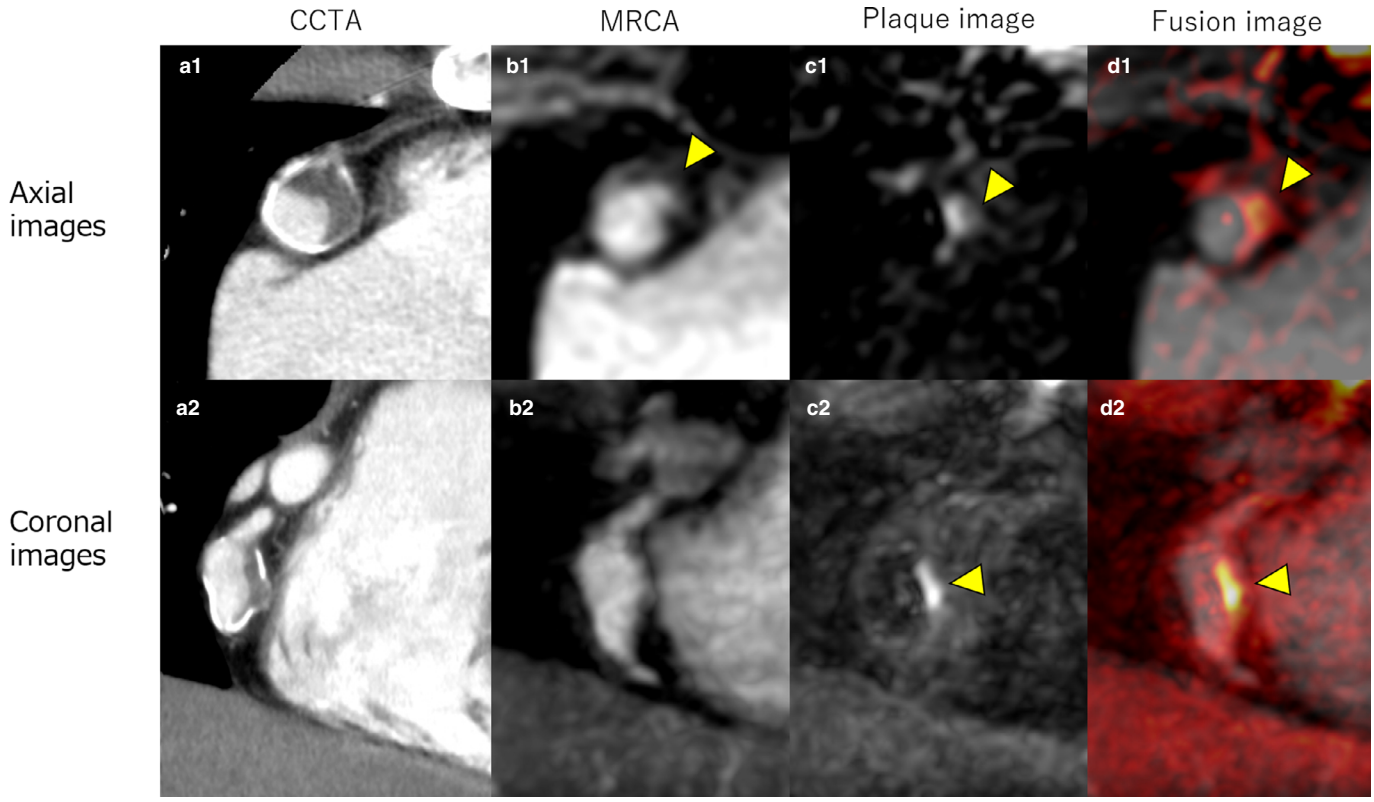


**Fig. 2** (a) CCTA showed wall thrombus in an RCA aneurysm. (b) MRCA at the same level of CCTA showed thrombus was unclear (yellow arrowhead), but vascular lumen was irregular. (c) Thrombus was hyperintense in PI (yellow arrowhead). (d) In the fusion image, the thrombus (yellow arrowhead) in the aneurysm was clearly visualized by superimposing PI (c) on MRCA (b). CCTA, coronary computed tomography angiography; RCA, right coronary artery; MRCA, magnetic resonance coronary angiography; PI, plaque imaging.

epicardial fat, which have no blood flow signal, are depicted as low signals, making it difficult to distinguish between the wall thrombus and the epicardial fat. Using contrast media, the vessel wall can be visible as pale high signal but there is a risk of allergy to contrast media. In this study, we aimed to improve detection of wall thrombus by performing MRCA using the DIXON method, a fat-suppression technique.[3] The DIXON method increases the relative signal of the vessel wall and improves contrast due to the marked fat suppression of epicardial fat compared with conventional fat-saturated MRCA. However, it is still difficult to recognize wall thrombus, which is depicted as slightly low signal, between the high signal of the lumen and the markedly low signal of the epicardial fat.

Plaque imaging is a T1WI-based imaging technique that can non-invasively depict coronary artery walls and plaque.[4] In PI, the lumen of the vessel shows a markedly low signal due to the use of the black-blood technique, the normal vessel wall is a faint and high signal, plaque has a high signal, and epicardial fat has markedly low signal due to fat suppression. Although several reports have evaluated wall thrombus in KD by PI, pathological examination has shown that high signal lesions on PI in atherosclerotic lesions are intraplaque hematomas.[5] Combining the lumen information from MRCA with the wall information from PI enabled reliable and minimally invasive detection of wall thrombus. Furthermore, fusion images of MRCA and PI can correlate a position of a wall thrombus within a coronary aneurysm.

The limitation of the proposed method is that it requires two acquisitions: MRCA and PI. It becomes challenging to create a fusion image if the acquisition time is extended or if the body position shifts. In future studies, more information should be obtained in a larger number of patients and the findings after thrombolysis should be examined.

In the present patient who was affected by KD, a coronary aneurysm thrombus was visualized as a high signal-intensity lesion on combined non-contrast MRCA and plaque imaging using T1WI. This method could be used for non-invasive follow-up of coronary aneurysms caused by Kawasaki disease.

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## Disclosure

The authors declare no conflict of interest.

## Author contributions

A.K. and K.A. designed the study; A.K. performed the experiments; A.K. collected and analyzed the data and performed image reconstruction; A.K., K.A. and T.Y. wrote the manuscript. All authors have read and approved the final manuscript.

## Informed consent

Written informed consent for MRCA was obtained from the patient and her legal guardians, and commercially available MRI sequences were used. Informed consent for publishing this case report was obtained from the her parents.

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