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Highly inflamed coronary plaque detected by Angio-CT in a 28-year-old patient with STEMI and long COVID-19

IMAGING

CASE REPORT

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ABSTRACT

Long COVID-19 syndrome increases the risk of cardiovascular events. Although rare in young people, acute coronary syndromes occur more often in those recently infected with COVID-19. This report discusses a rare case of myocardial infarction in a 28-year-old male with no prior medical issues, occurring four weeks after a mild COVID-19. Initially, the patient refused invasive coronary angiography, so a coronary computed tomography angiography (CCTA) was conducted during an ST-elevation myocardial infarction (STEMI). The CCTA, using fat attenuation index (FAI) technology, revealed significant inflammation at the culprit lesion. This CCTA and FAI analysis were done shortly after the STEMI onset, before revascularization, highlighting the case's uniqueness. In patients with recent COVID-19, CCTA combined with FAI analysis of perivascular inflammation can help identify those at risk for acute coronary events. In this case, FAI analysis detected high inflammation, suggesting a potential cause for STEMI in a young patient with long COVID-19.

KEYWORDS

long COVID-19 syndrome, acute myocardial infarction, coronary computed tomography angiography, fat attenuation index, perivascular inflammation

Introduction

The COVID-19 pandemic has affected over 675 million people, causing more than 6.8 million deaths. Post-COVID-19, hypercoagulability syndromes like deep vein thrombosis, pulmonary embolism, and acute myocardial infarction (AMI) have emerged [1]. SARS-CoV-2 is linked to acute coronary syndromes (ACS) through inflammation, leading to cardiovascular complications, even without traditional risk factors [2]. Long COVID-19 causes persistent cardiovascular effects, especially coronary artery inflammation, raising risks even in young, healthy individuals. While ACS is rare in young people, recent reports show an increase due to lifestyle factors like stress and drug use [3]. Fat attenuation index (FAI) technology via coronary computed tomography angiography (CCTA) quantifies perivascular fat inflammation, helping detect coronary inflammation and atherosclerotic changes in COVID-19 survivors [4, 5].

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This report describes a very rare case of AMI in a 28-year-old male patient with no previous medical history, occurring after a mild form of COVID-19 infection, in whom very high inflammation was depicted by FAI technology at the level of the culprit lesion.

Case presentation

We present the case of a 28-year-old male with no prior cardiovascular history who arrived at the emergency department with severe chest pain that began 9 h earlier. He appeared diaphoretic, restless, and pale. His vital signs were heart rate 91 bpm, blood pressure 131/88 mmHg, and oxygen saturation 97%. Risk factors included grade 1 obesity (BMI: 32.6 kg m^{-2}) and smoking, but no family history of cardiovascular issues.

Four weeks earlier, he experienced mild COVID-19 symptoms, including loss of smell and taste, confirmed by a positive RT-PCR test. His electrocardiogram (ECG) showed ST-segment elevations in the antero-lateral wall and leads V1 to V3. A transthoracic echocardiogram revealed a reduced ejection fraction of 42% and hypokinesis of the interventricular septum and left ventricular apex. Laboratory results showed mild hypokalemia (3.41 mmol L^{-1}), a white blood cell count of 13,290/mm^3, total cholesterol of 171.3 mg dL^{-1}, decreased high-density lipoprotein cholesterol of 29.68 mg dL^{-1}, elevated low-density lipoprotein cholesterol of 142.2 mg dL^{-1}, and elevated triglycerides of 386.8 mg dL^{-1}. The creatine kinase-MB level was 27.4 U/L, and the high-sensitivity troponin-I level was 2,628 ng L^{-1}.

Considering the chest pain, ECG changes with ST-segment elevation, and positive cardiac biomarkers, we considered two diagnoses: ST-elevation myocardial infarction (STEMI) or post-COVID-19 myocarditis. Given the patient's young age, favoring myocarditis, and his refusal of invasive coronary angiography (ICA), we performed an urgent CCTA to rule out coronary occlusion. Surprisingly, the CCTA revealed a sub-occlusive stenosis in the proximal left anterior descending artery (LAD) caused by a non-calcified plaque with signs of vulnerability, including positive remodeling and low-density atheroma (Fig. 1).

The patient was urgently referred for ICA, which confirmed significant stenosis in the proximal LAD (Fig. 2A). Optical coherence tomography (OCT) confirmed the presence of an unstable plaque with overlapping thrombotic material (Fig. 2B). The patient underwent immediate revascularization with a 3.5 × 33 mm drug-eluting Xience Pro stent (Abbott, Chicago, USA) implanted in the ostial LAD. Post-dilatation using a 4 × 15 mm non-compliant TREK balloon (Abbott, Chicago, USA) achieved TIMI 3 flow (Fig. 2C). Following the procedure, OCT confirmed the correct stent placement (Fig. 2D).

Before discharge, the patient received advice on reducing risk factors. During follow-up, he recovered smoothly and resumed physical activities without recurrent angina. A cardiac magnetic resonance examination six weeks later showed no significant wall motion disorders or myocardial necrosis.

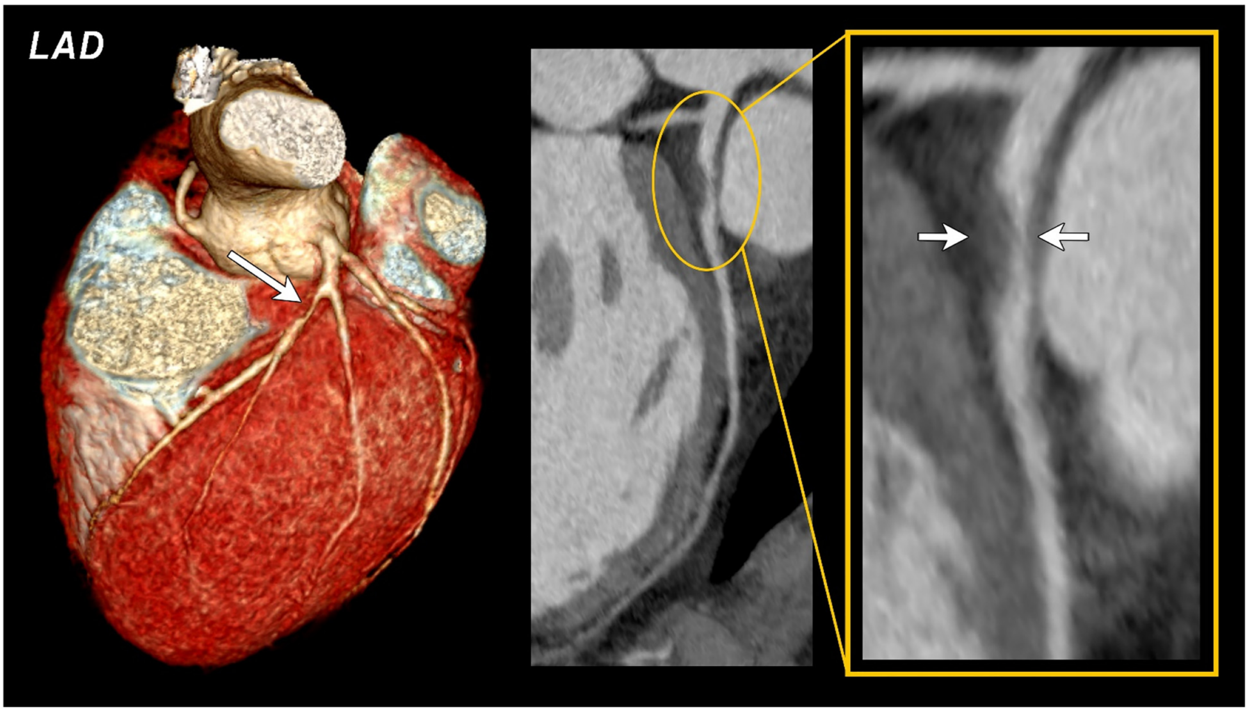

Fig. 1. CCTA scan revealed sub-occlusive stenosis in the proximal left anterior descending artery (LAD) (white arrows), which represents a high-risk anatomy. This was caused by a non-calcified plaque showing clear signs of vulnerability (positive remodeling and low-attenuation plaque)

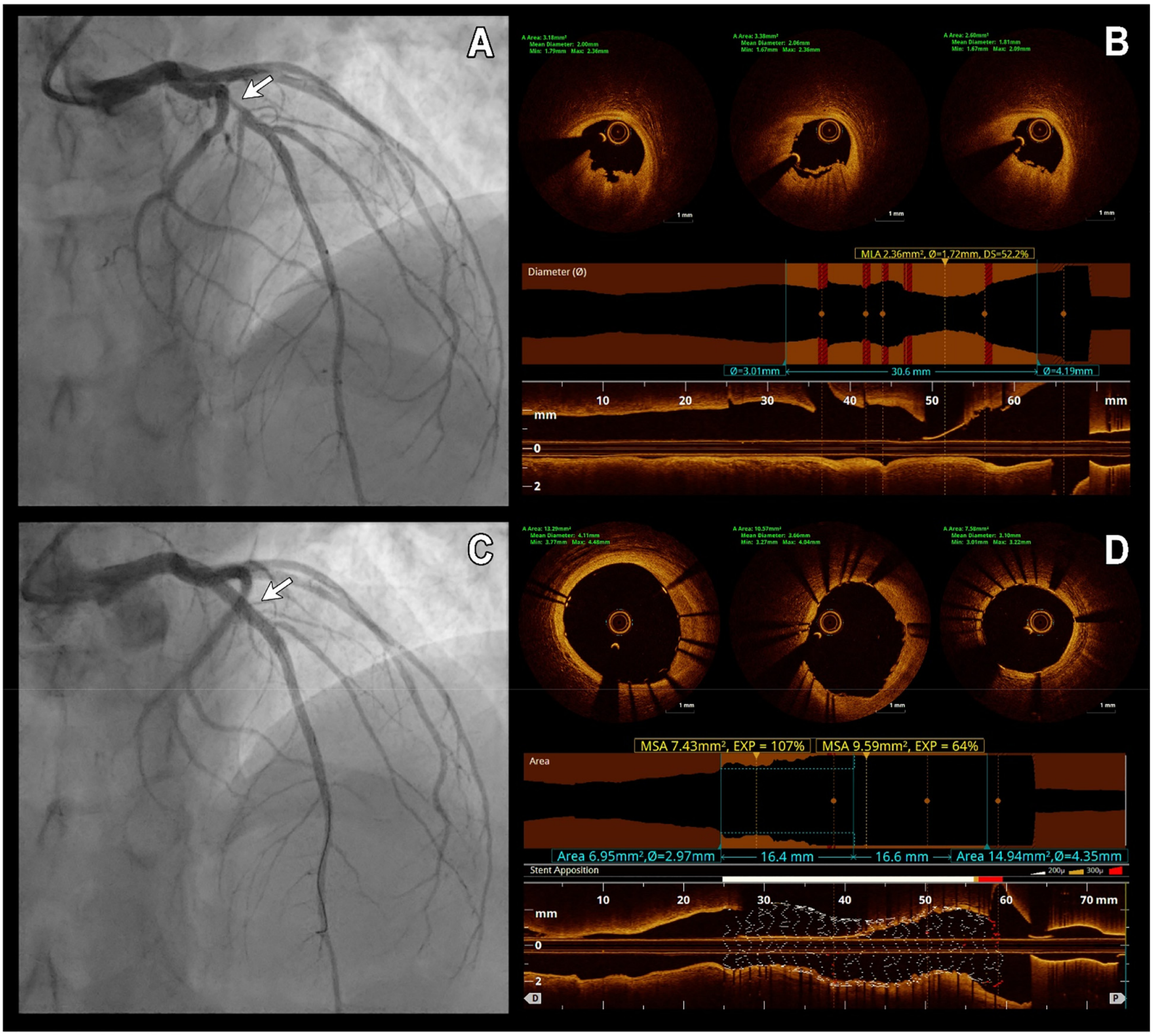

Fig. 2. Invasive coronary angiography with OCT of the culprit lesion before and after stenting. Panel A - Coronary angiography showing a critical stenosis at the proximal LAD. Panel B - OCT recording revealing plaque erosion and intracoronary thrombus. Panel C - angiographic outcome of the revascularization and stenting of LAD, with postprocedural TIMI 3 flow. Panel D – postprocedural OCT with evidence of correct stent placement

To assess inflammation at the culprit lesion, CCTA scans were sent to Caristo Diagnostics in Oxford, UK, for FAI analysis. The results showed severe vascular inflammation at the LAD lesion, with a FAI score of 1.2 (Fig. 3). This score is in the 47th percentile for coronary inflammation in a 28-year-old, significantly higher than average.

Discussion

Acute STEMI in young individuals without prior cardiovascular disease has been increasing recently, but it remains rare, particularly in those under 35, leading to under-recognition in clinical practice. While young STEMI patients generally have lower mortality rates, the risk of heart failure and sudden death is significant [3, 6].

Managing STEMI in very young patients presents unique challenges. Cardiac biomarkers are vital in emergency departments for managing chest pain and ACS, but they cannot always rapidly rule out ACS [6]. Adhesion molecules, which act as biomarkers, may help predict acute cardiovascular events [7]. In this case, the patient's classic AMI symptoms required emergency ICA. However, due to the patient's refusal of invasive procedures, CCTA was performed to visualize the coronary arteries. This is reportedly the first STEMI case where CCTA was conducted in an acute setting before ICA, and the first to use FAI technology to assess pericoronary inflammation within hours of STEMI onset, prior to revascularization.

European guidelines recommend urgent ICA for all STEMI cases presenting in time for revascularization, so there is limited data on the CCTA appearance of coronary

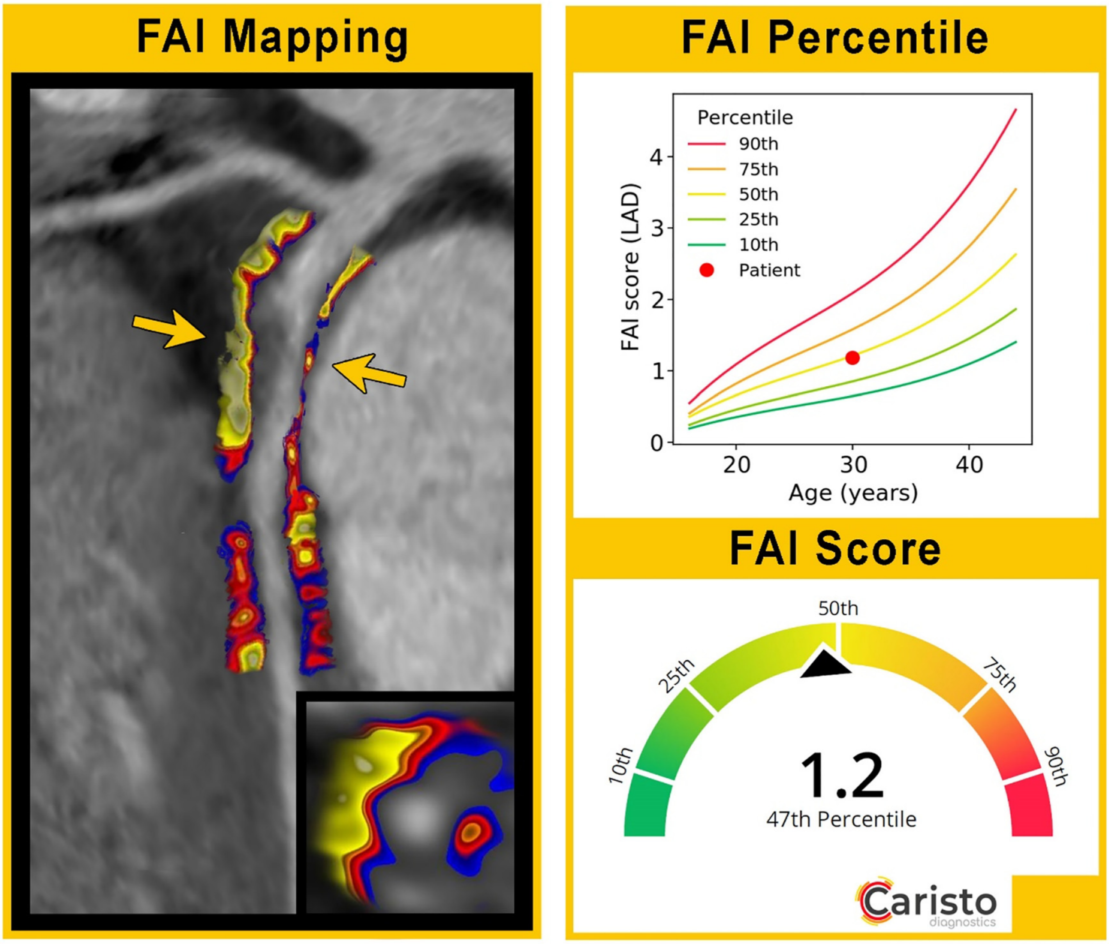

Fig. 3. Analysis of coronary inflammation and calculation of Fat Attenuation Index (FAI) at the level of the culprit lesion. FAI analysis was performed using the patented technology of the Centre of Caristo Diagnostics in Oxford, UK. Pericoronary adipose tissue is color-coded according to the level of inflammation. Red and blue colors represent areas with high inflammation, while yellow color indicates areas with low inflammation. Calculated FAI score was 1.2, which falls in the 47th percentile for coronary inflammation at this age, a value significantly higher than the average for the same age and gender group

plaques during STEMI. In this instance, CCTA replaced ICA at the patient's request, providing valuable insights into local inflammation's role in AMI.

This case emphasizes the importance of considering STEMI in young patients with chest pain, regardless of traditional risk factors, and the necessity of urgent diagnostic investigations to guide revascularization. Timely intervention is critical in young STEMI patients, as their disease mechanisms and treatment approaches differ from older populations, requiring tailored strategies [2, 4, 8, 9].

Long COVID-19 syndrome is associated with significant cardiovascular complications, including palpitations and chest pain, suggesting severe heart impacts in survivors. CCTA with FAI is crucial for detecting inflammation in coronary-adjacent fat tissue, highlighting cardiovascular consequences in long COVID-19 patients [4, 6, 10].

We believe that long COVID-19 triggered increased inflammatory response in the coronary arteries, leading to STEMI in this young patient. FAI analysis of local inflammation helped explain this rare complication of COVID-19 in this age group.

Conclusion

In patients with a recent history of COVID-19, CCTA combined with FAI analysis of perivascular inflammation can help identify those at risk of acute coronary complications. In our case, FAI analysis revealed a significantly higher level of inflammation at the culprit plaque site, indicating a possible cause for STEMI in a very young patient with long COVID-19.

Authors' contribution: All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the development of concept, writing, or revision of the manuscript. Image acquisition: NR, BBM, and IB. Interventional procedures: BB, BBM. Analysis and/or interpretation of literature: NR, BBM, TB. Drafting of the manuscript: NR, BBM, and TB. Revising the manuscript critically for significant intellectual content: TB, IB, CFB.

Conflicts of interest: The authors declare no conflict of interest.

Ethical statement: The current research received approval from the Institutional Review Board in alignment with the ethical guidelines set forth in the 2013 Helsinki Declaration and its subsequent modifications or equivalent ethical benchmarks.

Consent to participate: The informed consent requirement was waived by the Institutional Review Board.

Consent for publication: The study received approval from the institutional review board, which also granted a waiver for the requirement to obtain informed consent.

Availability of data and material: The data are available upon reasonable request to the corresponding author.

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