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MINI-FOCUS ISSUE: IMAGING

ADVANCED

CASE REPORT: CLINICAL CASE

Cardiac Computed Tomography to Identify and Guide Therapy of Intramural Hemorrhage in High-Risk Coronary Anatomy

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ABSTRACT

Coronary intramural hematoma can present with acute coronary syndrome. We present a 39-year-old man with post-assault stress-induced left main intramural hematoma. We used computed tomography coronary angiogram with lesion characterization and suspected the diagnosis of intramural hematoma despite its limited spatial resolution; computed tomography was used for follow-up imaging and proper monitoring of therapeutic measures.
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A 39-year-old man with no history of systemic illness and no cardiac risk factors was admitted to the hospital with typical cardiac-sounding chest pain. Pain responded to glyceryl trinitrate spray. His troponin T level showed dynamic change from 47 to 358 ng/l (normal range is <14 ngl/l) without significant ischemic changes on his electrocardiogram. He was treated for acute coronary syndrome (ACS). Due to the nature of the presentation, ACS or acute myocarditis remained the initial differential diagnosis.

MEDICAL HISTORY

The patient was admitted 10 days earlier to the emergency department with roadside assault and stab injuries over his left lower back and right flank area. His computed tomography (CT) scan of chest, abdomen, and pelvis did not show any internal injuries and he was discharged with dressing and analgesics.

LEARNING OBJECTIVES

- CTCA with lesion characterization can help in the diagnosis of nonatherosclerotic coronary artery lesions including IMH. CTCA is useful for the investigation of patients with low-risk of CAD and presenting with ACS.
- Lesion characterization using CTCA may add useful information in decision making and follow-up of medical therapy as the optimal therapy of choice in IMH-related lesions at high-risk anatomy.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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INVESTIGATIONS

He became pain free shortly after admission and underwent CT coronary angiogram (CTCA) using Siemens Somatom Definition FLASH (Forcheim, Germany) with standard low-dose prospective CTCA protocol using tri-phasic injection protocol (60 ml iodinated contrast media). Isotropic CT image reconstruction was used with 0.6-mm slice thickness and 0.3-mm increment for further lesion characterization (QAngioCT, Medis, Leiden, Netherlands). CTCA confirmed a 0 calcium score and an inhomogeneous, obstructive lesion in the left main coronary artery (LM) (**Figures 1A to 1C**). The central core of the lesion showed low attenuation. The presented LM pathology on CTCA images suggested rather non-atherosclerosis but possibly post-assault, psychological stress-driven intramural hemorrhage (IMH) (possibly due to initial admission with history of assault) extending from adventitia of LM toward the lumen sealed by the intact intima. No atherosclerotic disease was identified elsewhere in other coronary artery segments. Due to the nature of high-risk anatomic lesion, the patient was urgently transferred for invasive coronary angiography (**Figures 1D and 1E**) with the aim of intravascular ultrasound (IVUS)-guided coronary intervention. The IVUS confirmed the presence of significant lesion and supported the presence of suspected IMH with intact vessel intima and no sign of plaque rupture (**Figures 1F and 1G**). CTCA image set (**Figures 1H and 1I**) was used for further color-coded lesion characterization to delineate the different compartments in the vessel wall (**Figures 1J and 1K**). The patient was treated medically using dual antiplatelet therapy and high-dose statin with the plan of follow-up CTCA scan in 3 months. The follow up CTCA (**Figures 2A and 2B**) confirmed close to complete resolution of IMH with minimal residual intimal thickening in the previously affected LM vessel (**Figures 2C to 2E**). The presented case confirmed the correlation between lesion characterization provided using acute CTCA and invasive coronary angiography with IVUS.

MANAGEMENT

The patient was initially treated as having ACS with dual antiplatelet therapy, high-dose statin, beta blocker, and angiotensin-converting enzyme inhibitor. After CTCA and invasive angiogram with IVUS, his case was discussed in multidisciplinary team meeting (MDT). MDT decided to delay the decision of percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery, noting that the patient became pain free and the electrocardiogram showed no ACS-related changes. Accordingly, optimal medical therapy with dual antiplatelet cover and high-dose statin was continued with the plan of follow-up CTCA in 3 months.

DISCUSSION

Spontaneous coronary artery dissection (SCAD) is defined as a separation of the coronary arterial walls, creating a false lumen due to vessel wall injury. Isolated spontaneous coronary IMH is a unique subset of SCAD where hemorrhage is located between medial-adventitial layers without visible intimal flaps with poorly understood pathogenic mechanisms (1).

IMH can be formed either by an intimal tear resulting in blood from the endoluminal space entering the intimal space or due to rupture of the vasa-vasorum, which are specialized micro-vessels within the walls of arteries supplying blood to the walls (1).

SCAD is usually diagnosed on invasive coronary angiography; intracoronary imaging (such as IVUS) can be used for confirmation in indeterminate cases, often by visualizing an IMH (2). The use of CTCA was previously reported in only a limited number of cases. Ducas et al. (3) reported a case of a postmenopausal woman with multi-vessel IMH when some of the lesions were treated with selective PCI and CTCA was carried out 24 h post-PCI, confirming abnormal soft tissue of distal right coronary artery with luminal progression (3). Liu et al. (4) reported a postpartum case with a diffuse nonfocal left anterior descending stenosis. CTCA was used in combination with IVUS-guided invasive coronary angiography in the diagnosis of IMH. In the presented case, we showed IMH in the high-risk anatomy of LM with rather focal appearance with cardiac CT-based lesion characterization and we suspected the nature of significant flow-limiting stenosis. Using IVUS in the presented case confirmed CTCA findings and proved further the presence of intact media and the absence of plaque rupture. Uniquely, CTCA was used to follow up and monitor the success of the chosen medical therapy in the presented significant LM stenosis. Trivi et al. (5) also published a case with ACS presentation with diffuse, concentric appearance of stenosis of the distal left anterior descending artery, opposite to our case report with focal appearance in a high-risk anatomy.

The proposed lesion characterization of the presented focal LM stenosis can guide accurate decision making and help to monitor the impact of medical

ABBREVIATIONS AND ACRONYMS

ACS = acute coronary syndrome
CT = computed tomography
CTCA = CT coronary angiogram
IMH = intramural hemorrhage
IVUS = intravascular ultrasound
LM = left main
MDT = multidisciplinary team meeting
PCI = percutaneous coronary intervention
SCAD = spontaneous coronary artery dissection

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FIGURE 1 **Initial Presentation**

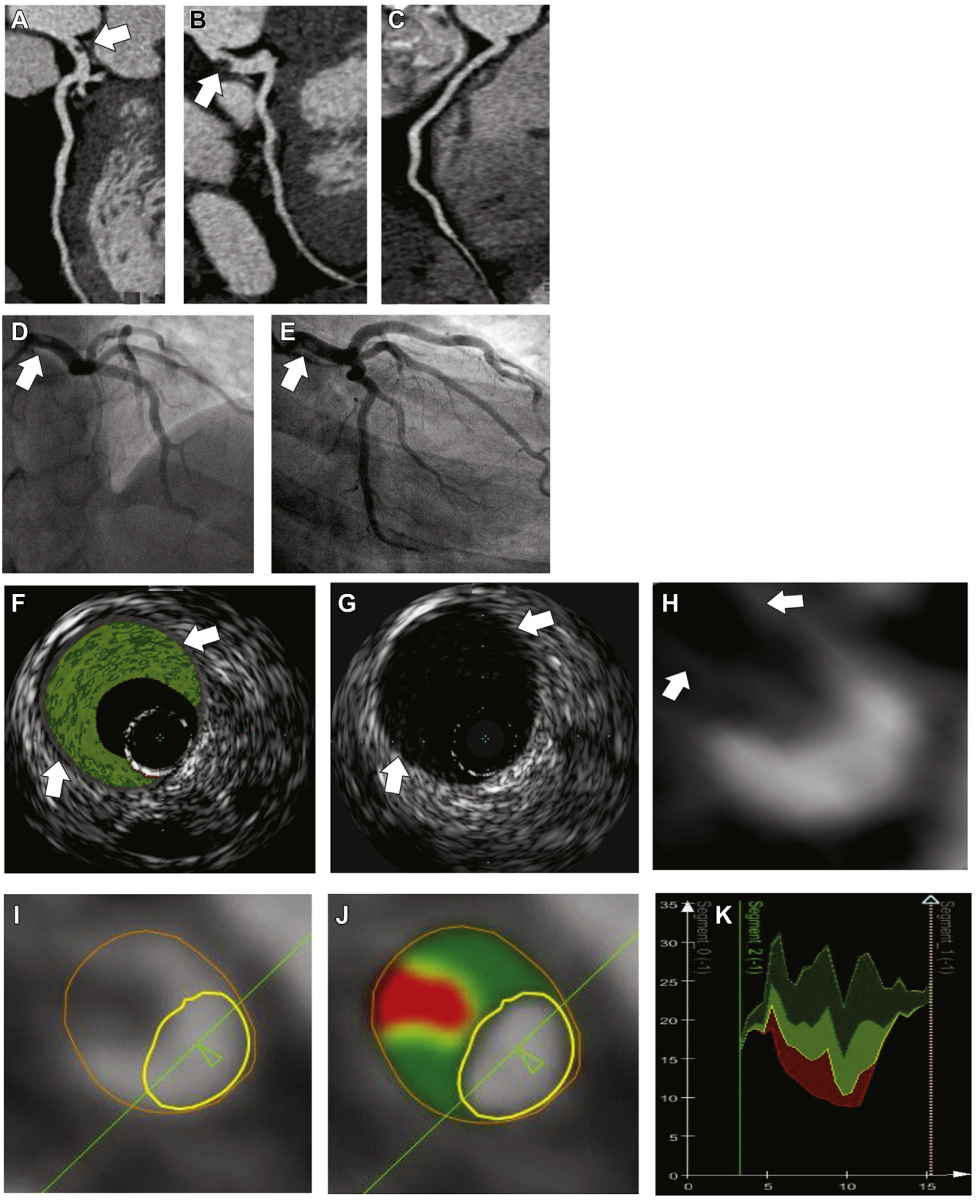

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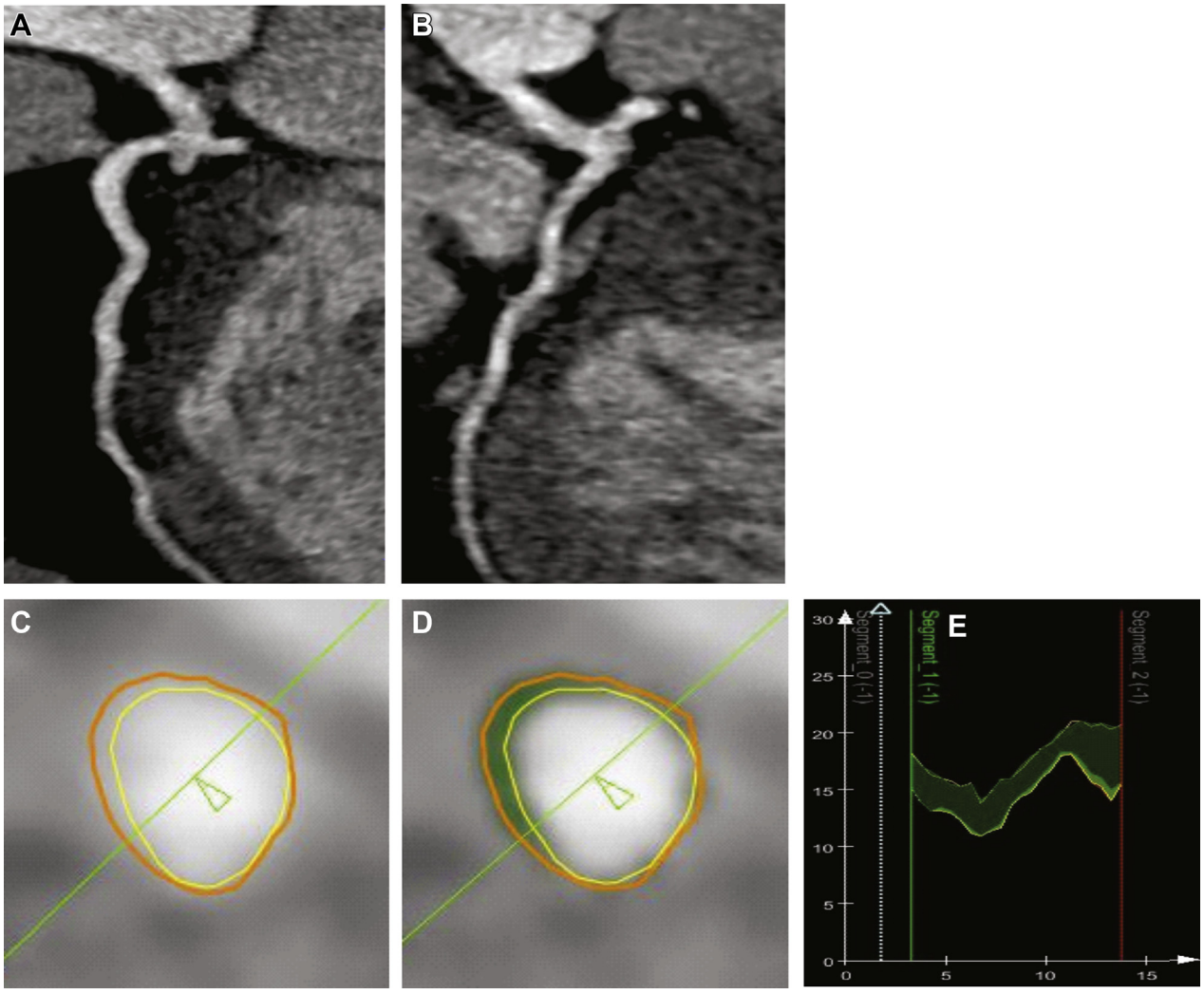
FIGURE 2 Follow-Up Presentation



Resolution of IMH delineated using CTCA and corresponding coronary artery lesion characterization. Repeated CTCA in 3 months **(A and B)** shows significant resolution of LM lesion and disappearance of low-attenuation, hemorrhagic component. Only mild residual intimal thickening confirmed in the exact same area (10 mm distal to LM ostium) **(C and D)** depicted by the corresponding tissue characterization graph **(E)** showing a prominent reduction in the volume of hematoma to 0.25 mm^3 (which represents 1% relative to the entire lesion volume). Abbreviations as in Figure 1.

FIGURE 1 Continued

Intramural hemorrhage (IMH) delineated by computed tomography (CT) coronary angiogram (CTCA) and corresponding invasive coronary angiogram with intravascular ultrasound (IVUS) and coronary artery lesion characterization. Curved multiplanar reformat views of left main (LM) and left anterior descending **(A),** LM and left circumflex artery **(B),** and right coronary artery **(C)** show significant high-risk anatomy lesion as single-vessel LM disease **(arrow)**. Invasive coronary angiogram **(D and E)** proves the CTCA findings and delineates the significant corresponding LM lesion **(arrow)**. IVUS shows the complex lesion around LM with color-coding extravascular component **(F)** and monochrome delineation **(G)** with intact intimal border. Multiplanar reformat CTCA images showing low-attenuation core and the lesion within the vessel wall **(arrows) (H)**. CTCA 10 mm from the LM ostium shows the corresponding LM vessel lumen with complex, heterogenous component within the lesion **(I)**. The low-attenuation area **(arrow)** was covered and sealed by the intimal compartment. Color-coded tissue characterization **(J)** revealed a low-attenuation component suggestive of IMH coded using red color; vessel wall including endothelium is coded using light and dark green color. Heterogenous compartments are depicted on a tissue characterization graph showing the dominance of red color-coded, hemorrhagic component **(K)** detecting an attenuation threshold of -100 to 30 HU representing 22% of the entire lesion volume with an absolute volume of 28 mm^3.

therapy. In addition to previously reported cases with SCAD, acute CTCA as a quick noninvasive imaging modality can potentially be considered as first-line investigation when post-assault or emotional stress has a suspected impact on ACS-type clinical presentation in young individuals with no cardiac risk factors.

Although the limited literature is generally aspirational regarding the use of CTCA in patients with SCAD, there is limited evidence to our knowledge describing acute SCAD with features of IMH in high-risk anatomy (LM) on CTCA with focal appearance.

CTCA-based lesion characterization in the presented case showed correlation with IVUS findings at the corresponding LM coronary artery segment. The presented findings substantially contributed to decision making in MDT for conservative management.

FOLLOW-UP

He was reviewed in 3 months with repeat CTCA. He was asymptomatic and follow-up CTCA confirmed close to complete resolution of IMH with minimal residual intimal thickening in the previously affected LM vessel.

CONCLUSIONS

The presented case confirmed the role of acute CTCA with intramural hemorrhagic lesion characterization in high-risk anatomy. Findings were complemented by invasive coronary angiography and IVUS.

CTCA in similar cases may further help to guide medical therapy as an optimal therapy of choice over interventional angioplasty or coronary artery bypass graft surgery when CT-based lesion characterization suggests a hemorrhagic nature of acute vessel injury.

AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS acute coronary syndrome, computed tomography coronary angiography, coronary intramural hematoma