

Novel use of spectral computerized tomography in acute myocarditis

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A 75-year-old male presenting a sudden syncope was referred for coronary angiography due to suspicion of myocardial infarction. The patient suffered from a metastatic renal carcinoma on the second-line therapy with nivolumab, with two monthly doses administered, the last dose 3 weeks before admission. The electrocardiogram showed a third-degree atrioventricular block with ST-segment elevation from V1 to V4 and V3R to V5R leads (Figure 1A). The emergent angiography showed no coronary occlusion, but a significant mid-left anterior descending artery lesion was detected and treated (see Supplementary material online, Videos S1 and S2). Despite revascularization, electrocardiographic abnormalities persisted, and a new episode of syncope occurred, leading to the implantation of a temporary pacemaker. Because of progressive clinical and echocardiographic deterioration with severe right ventricular dysfunction (see Supplementary material online, Videos S3–S5), pulmonary embolism was ruled out, and myocardial tissue characterization became indispensable. Given the clinical instability and that temporary pacing device precluded from a cardiac magnetic resonance (CMR), a dual-energy cardiac computerized tomography (CT) study was performed (Spectral CT 7500, Philips Healthcare). Patchy non-ischaemic areas of late iodine enhancement located in the interventricular septum and left ventricular inferolateral wall were detected in the virtual low-monoenergetic reconstruction (40 keV) (Figure 1B) matching areas of high atomic number in the Z-effective map (Figure 1C). These findings were consistent with myocarditis likely related with the immune checkpoint inhibitor (ICI) treatment. Therefore, high-dose intravenous corticosteroids

were started leading to a progressive atrioventricular conduction recovery enabling the temporary lead withdrawal 5 days later. The subsequent CMR study showed non-ischaemic patchy areas of oedema (increased T_2 values) and late gadolinium enhancement (Figure 1D and E, respectively) confirming the diagnosis of myocarditis.

We report a case of myocarditis likely related to ICI treatment diagnosed with spectral CT technology. Dual-energy cardiac CT represents a promising tool for detecting myocardial inflammation in unstable patients with contraindications for CMR.^{1–5}

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

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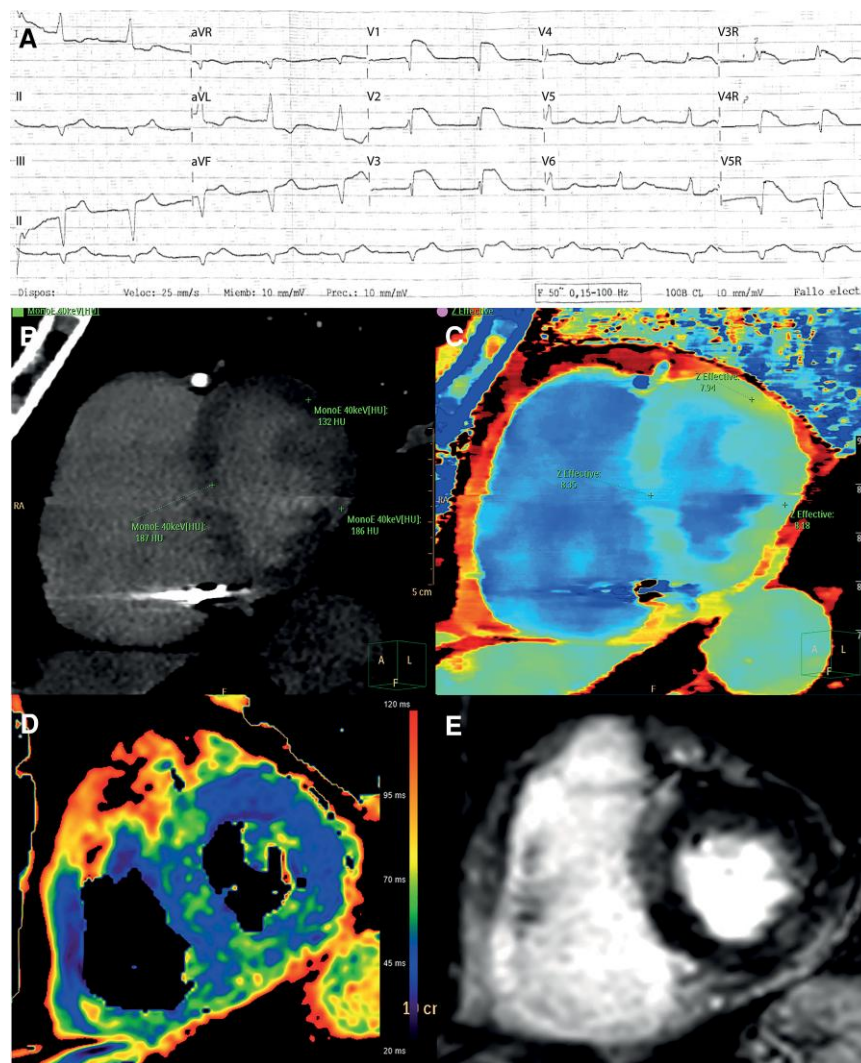


Figure 1 (A) First contact electrocardiogram showing sinus rhythm with a third-degree atrioventricular block and an infrahisian escape at 35 b.p.m. Note ST-segment elevation from V1 to V4 and V3R to V5R leads. (B and C) Dual-energy computerized tomography late iodine enhancement virtual images acquired 48 h after admission. Virtual monoenergetic reconstruction at low 40 keV (B) revealed patchy areas of high attenuation in the inter-ventricular septum and left ventricular inferior and inferolateral wall with attenuation values around 190 Hounsfield units compared with 132 Hounsfield units in the healthy remote myocardium. This correlated well with the areas of high atomic number values (8.35 vs. 7.94) in the Z-effective images (C) consistent with non-ischaemic late iodine enhancement. (D and E) Cardiac magnetic resonance imaging performed after withdrawal of the temporary pacemaker. T_2 map (D) and late gadolinium-enhanced T_1 -weighted magnetic resonance sequences (E) of the short axis revealed patchy areas of oedema (increased T_2 values) that correlated with a non-ischaemic enhanced areas in the septum and inferolateral wall segments and in the mid segments of the right ventricular free wall. Note the good correlation of the injured areas between the dual-energy computerized tomography and cardiac magnetic resonance images.

Data availability

The data underlying this article are available in the article and in its online [supplementary material](#).

References

- Bouleti C, Baudry G, lung B, Arangalage D, Abtan J, Ducrocq G. Usefulness of late iodine enhancement on spectral CT in acute myocarditis. *JACC Cardiovasc Imaging* 2017;**10**: 826–827.
- Oda S, Emoto T, Nakaura T, Kidoh M, Utsunomiya D, Funama Y, et al. Myocardial late iodine enhancement and extracellular volume quantification with dual-layer spectral detector dual-energy cardiac CT. *Radiology Cardiothoracic imaging* 2019;**1**: e180003.
- Ball S, Ghosh RK, Wongsangsak S, Bandyopadhyay D, Ghosh GC, Aronow WS, et al. Cardiovascular toxicities of immune checkpoint inhibitors: JACC review topic of the week. *J Am Coll Cardiol* 2019;**74**:1714–1727.
- Ferreira VM, Schulz-Menger J, Holmvang G, Kramer CM, Carbone I, Sechtum U, et al. Cardiovascular magnetic resonance in nonischemic myocardial inflammation: expert recommendations. *J Am Coll Cardiol* 2018;**72**:3158–3176.
- Barreiro-Pérez M, Cabeza B, Calvo D, Reyes-Juárez JL, Datino T, Vañó Galván E, et al. Magnetic resonance in patients with cardiovascular devices. SEC-GT CRMTC/SEC-Heart Rhythm Association/SERAM/SEICAT consensus document. *Rev Esp Cardiol (Engl Ed)* 2023;**76**:183–196.