

- generation computed tomography scanners. *Eur Heart J Cardiovasc Imaging* 2020; **21**:191–201.
19. Andreini D, Pontone G, Mushtaq S, Bartorelli AL, Bertella E, Antonioli L et al. A long-term prognostic value of coronary CT angiography in suspected coronary artery disease. *JACC Cardiovasc Imaging* 2012; **5**:690–701.
20. Pepine CJ, Ferdinand KC, Shaw LJ, Light-McGroary KA, Shah RU, Gulati M et al. Emergence of nonobstructive coronary artery disease: a woman's problem and need for change in definition on angiography. *J Am Coll Cardiol* 2015; **66**:1918–33.
21. Kruk M, Pregowski J, Mintz GS, Maehara A, Tyczynski P, Witkowski A et al. Intravascular ultrasonic study of gender differences in ruptured coronary plaque morphology and its associated clinical presentation. *Am J Cardiol* 2007; **100**:185–9.
22. Arbab-Zadeh A, Fuster V. The myth of the "vulnerable plaque": transitioning from a focus on individual lesions to atherosclerotic disease burden for coronary artery disease risk assessment. *J Am Coll Cardiol* 2015; **65**: 846–85.

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doi:10.1093/ehjci/jeaa157

Online publish-ahead-of-print 24 July 2020

Reverse Rivero-Carvalho's sign

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A middle-aged woman with chronic atrial fibrillation (AF) presented with dyspnoea on exertion. Physical examination showed a distended jugular vein, peripheral oedema, and positive Kussmaul's sign. In contrast to the Rivero-Carvalho's sign, the systolic murmur reduced during inspiration and increased during expiration (Panel A, [Supplementary data online, Sound S1](#)). The electrocardiogram showed sinus bradycardia instead of AF. Echocardiography confirmed dilated right atrium and ventricle with severe tricuspid regurgitation (TR). Furthermore, tricuspid annular (TA) dilatation during inspiration led to incomplete valve closure, increasing TR severity (Panel B, inspiration; Panel C, expiration, [Supplementary data online, Video S1](#)). Sudden changes from AF to sinus bradycardia were assumed to be the cause of right-sided heart failure. Cilostazol was administered to increase the heart rate and diuretics for volume reduction. Two weeks later, the patient improved with an increased heart rate, no jugular vein distension, and resolution of oedema. No cardiac murmurs were heard on inspiration or expiration, and echocardiography showed only mild TR. The Rivero-Carvalho's sign shows increase in systolic murmur of TR during inspiration. As venous return increases during inspiration, blood volumes in the right side of the heart and TR increase. This patient originally had severe TR, and the increased venous return during inspiration caused TA dilatation and incomplete valve closure, thereby increasing TR. This resulted in a laminar flow through the tricuspid valve, and the systolic murmur reduced. This phenomenon may be considered as very severe TR, where the tricuspid valve was separated during inspiration.

[Supplementary data](#) are available at *European Heart Journal - Cardiovascular Imaging* online.

