GE HealthCare

Advancements in imaging of Hypertrophic Cardiomyopathy

Courtesy of Denisa Muraru, FESC, FACC, MD, PhD, cardiologist at Istituto Auxologico Italiano, IRCCS, San Luca Hospital, Milan

Patient history/ pathology

- 53 year-old male patient with Hypertrophic Cardiomyopathy (HCM) with apical-midventricular obstruction (MVO), past history of surgical myectomy and apical aneurysmectomy (2015) with ICD implantation (2020)
- Last CMR (2020 before ICD): no residual LV aneurysm, LVEF 55%, therefore anticoagulant treatment was stopped
- Patient followed on different institutions-echocardiograms: normal LV size, stable LV systolic function (2D LVEF = 60%), no residual intracavitary gradient, meaning an optimal outcome after the procedure
- Patient continued to complain, with Dyspnea on exertion (NYHA II) with mild impairment of functional capacity, elevated NT proBNP (643). Treatment: beta-blocker, ACEI, statin

Challenges

- Previous sternotomy
- ICD not CMR compatible

System, probe & device used

- Vivid™ Pioneer
- 4Vc-D probe
- 6Sc-D probe

Step-by-step procedure

- Comprehensive 2D and 4D Echocardiography (4Vc-D probe)
- Focused apical 2D echocardiographic imaging (6Sc-D probe)

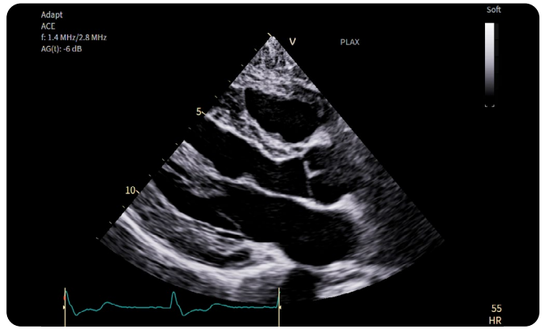
Conclusion

- HCM s/p surgical myectomy with apical aneurysm and residual dynamic obstruction at apical-midventricular level due to papillary muscles hypertrophy
- Latrogenic coronary-LV cavity fistula needs to be confirmed with second modality, typically coronary CT
- Mild LV dilation with mild systolic dysfunction
- Moderately dilated LA
- Mild MR
- Mild AR
- Mild TR associated with ICD lead (no interference) with normal RV size and function

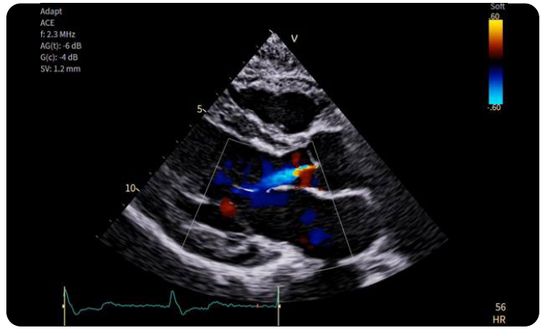
Follow-up

- NOAC was re-introduced and HF treatment was optimized
- Exercise stress echo and CPET scheduled to objectively assess the cause of symptoms and functional impairment
- Coronary CT to evaluate the coronary fistula and invasive hemodynamic assessment will be performed
- A multi-disciplinary discussion is to be held to evaluate the indication for percutaneous closure

1) 2D Echocardiography: Parasternal Long-Axis

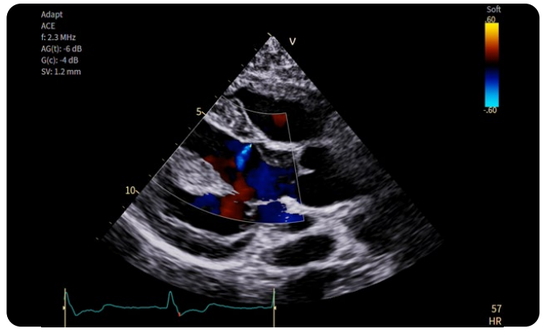


LVH with signs of septal myectomy, PM hypertrophy, no Systolic Anterior Motion (SAM)

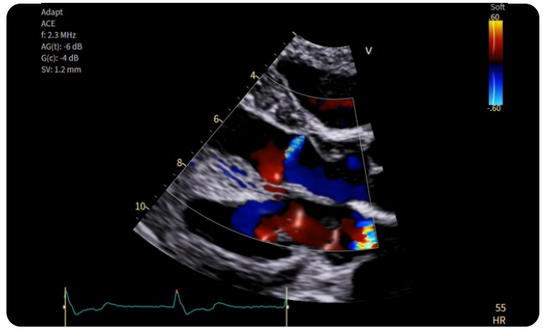


Mild central MR, mild central AR

2) 2D Echocardiography: Color Doppler and Radiant*flow*™

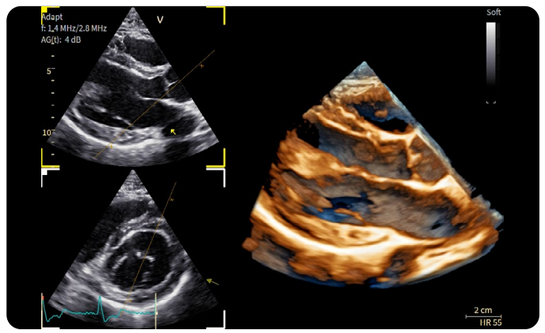


Thin diastolic jet flow between IVS and LV cavity

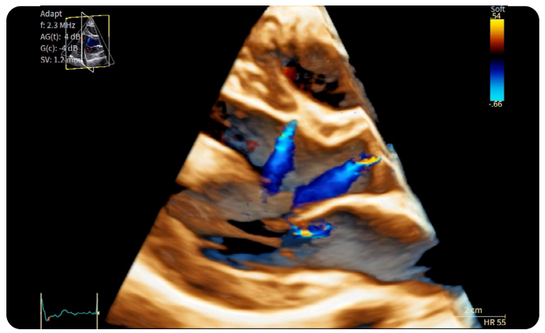


Radiant*flow* – to appreciate better the direction of the flow

3) True anatomical 4D echocardiography and Color Doppler

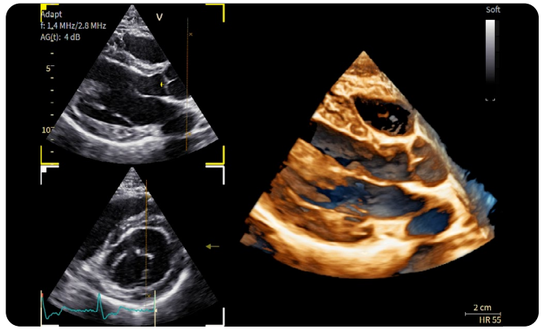


Residual thinning of the IVS after myectomy (6 mm) – No SAM – PM hypertrophy

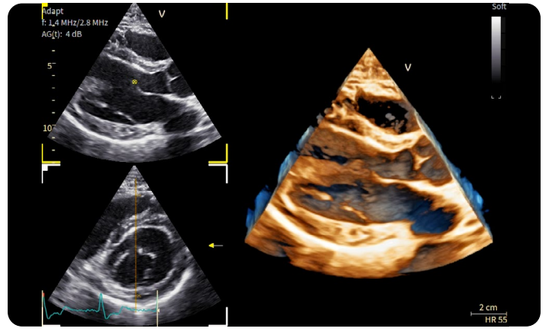


Three different lesions by Color Flow on the same image, in single-beat acquisition

4) 4D Echocardiography to better understand 2D limitations

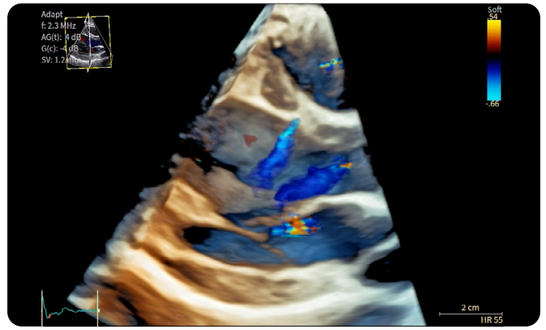


Residual thinning of the anterior IVS after myectomy

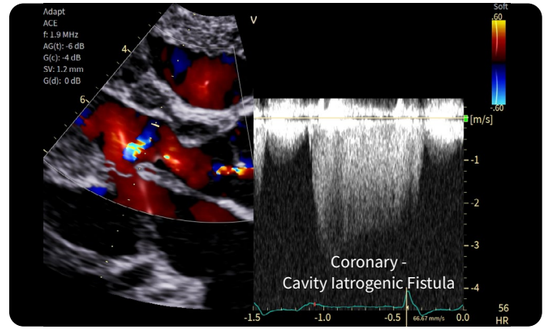


Residual thinning (and fistula origin) is missed

5) 4D Color and CW Doppler for better spatial and temporal definition

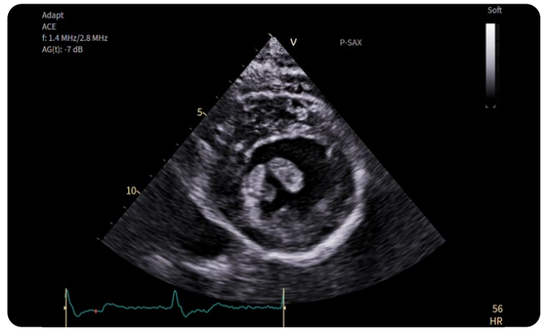


Cine rotate to better document jet localization and origin

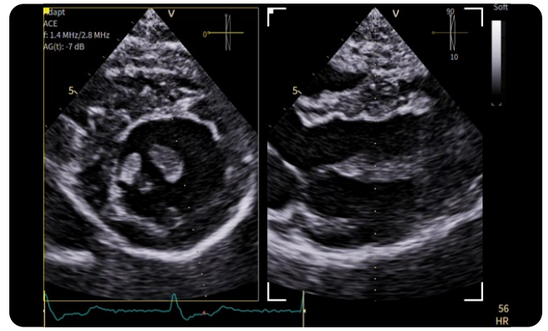


CW Doppler to better document jet direction and timing

6) 2D Echocardiography: Parasternal Short-Axis and Biplane

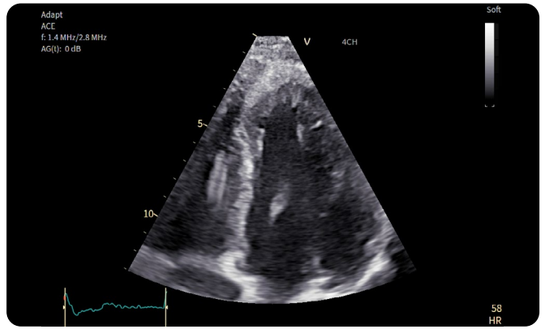


Bifid postero-medial PM – Displaced antero-lateral PM with systolic contact – No septal thinning

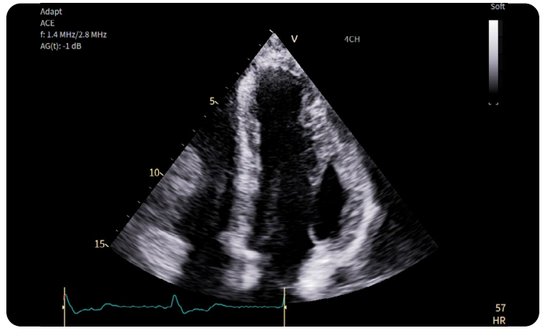


Biplane visualization of PM hypertrophy

7) 2D Echocardiography

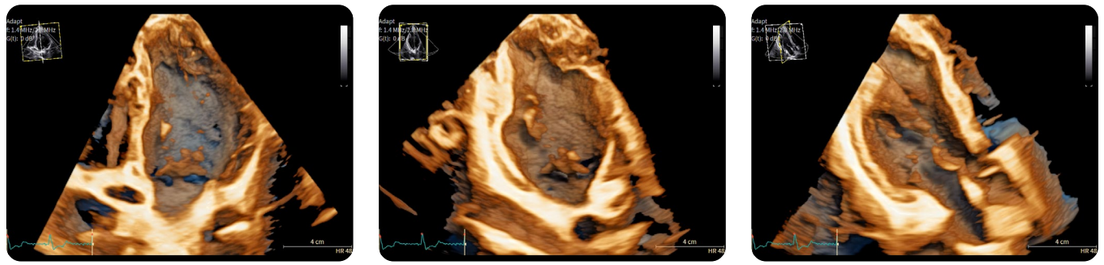


Apical – hypertrophic cardiomyopathy due to LV apical foreshortening in 2D apical 4-chamber



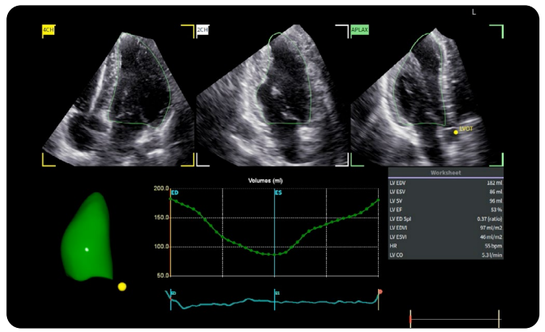
Apical aneurysm with mid-ventricular and PM hypertrophy

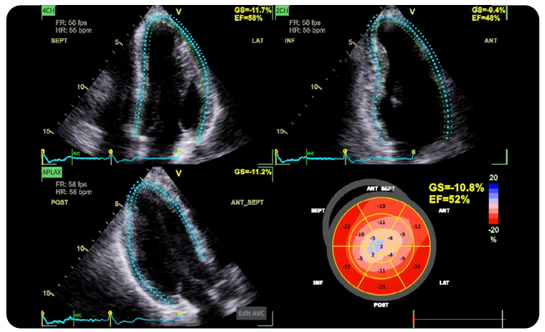
8) 4D Echocardiography: Apical Views



Clear visualization of the contours of the wall, extending to the farthest part of the myocardium, allows appreciation of the anatomical details and trabeculations, and helps confirm whether there is obstruction at the mid-cavity, including its location and mechanism

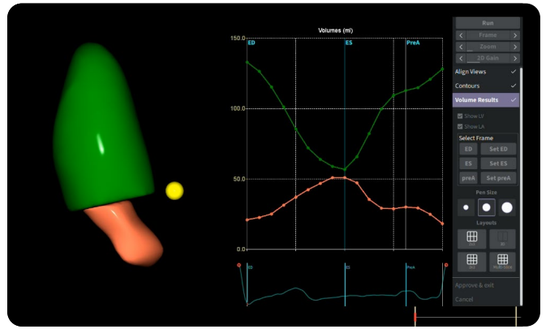
9) LV Volumes and Systolic Function





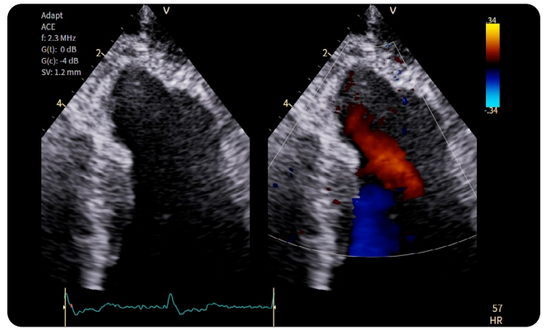
4D LHQ revealed that the patient already had left ventricular dysfunction (LV EF 53%, LV EDV 162 ml). The presence of the fistula could potentially add an additional hemodynamic burden to a ventricle already compromised by fibrosis and left ventricular hypertrophy

10) Assessment of LV – LA Coupling

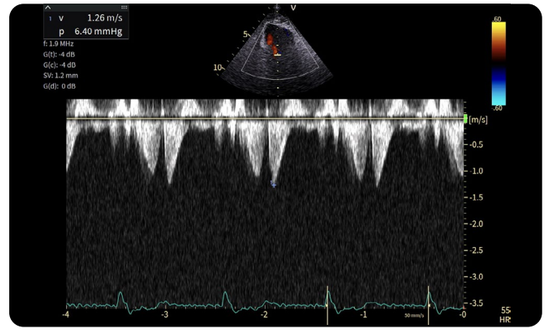


4D LHQ enables simultaneous acquisition and measurement of both the left ventricle (LV) and left atrium (LA), allowing assessment of their coupling — an important parameter for predicting the presence of atrial fibrillation in patients with hypertrophic cardiomyopathy

11) LV Apical Aneurysm

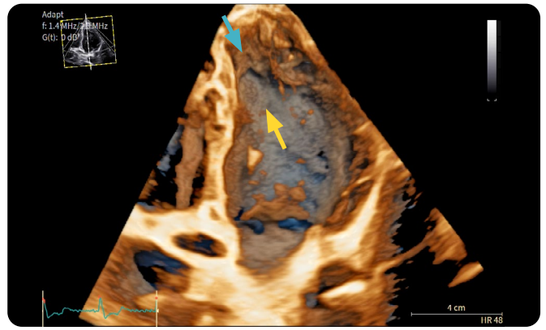


Color Doppler with biphasic flow from aneurysm

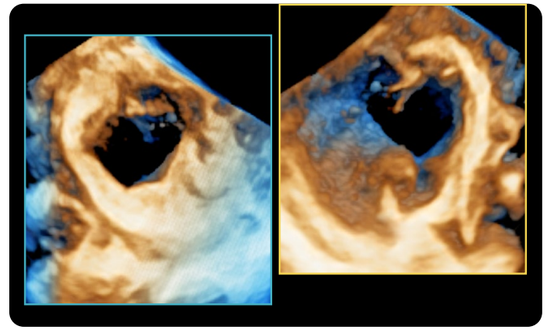


CW Doppler with “Lobster claw” sign

12) 4D anatomical assessment of LV obstruction

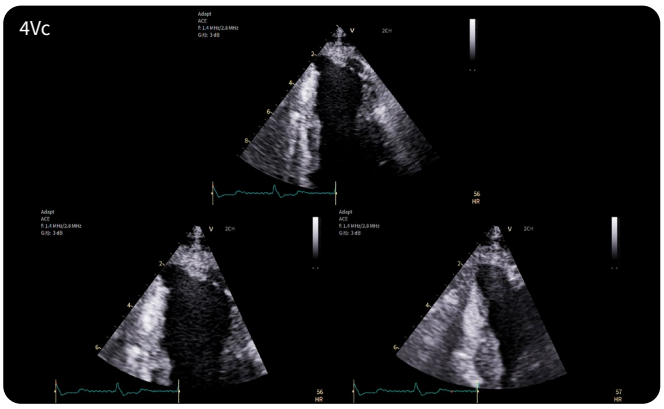


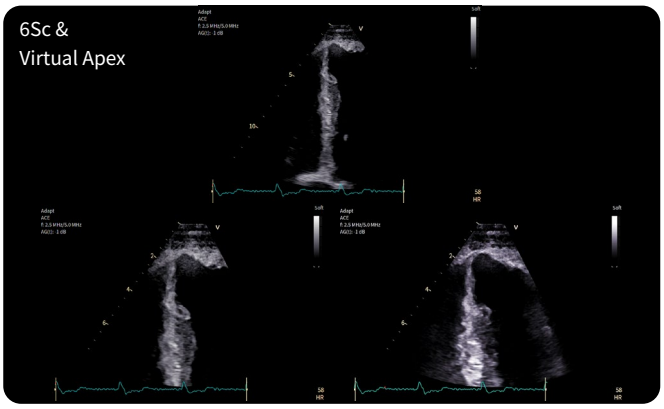
LV Dynamic Obstruction



LV Dual-Crop

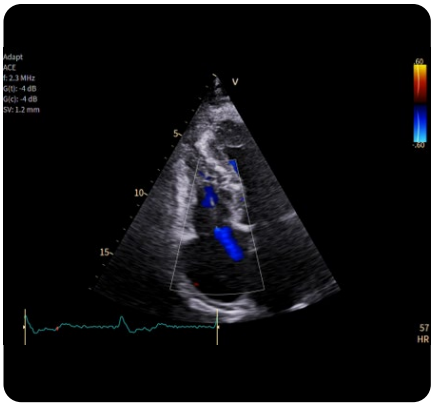
13) Aneurism assessment with 2D echocardiography



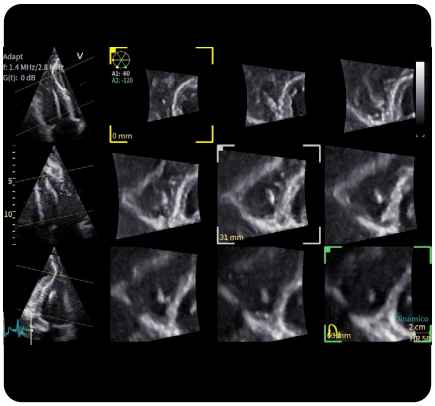


Comparison between the 4Vc-D and the 6Sc-D high-frequency probe demonstrated that the latter enabled clear apical visualization, confirming the absence of intracardiac thrombus

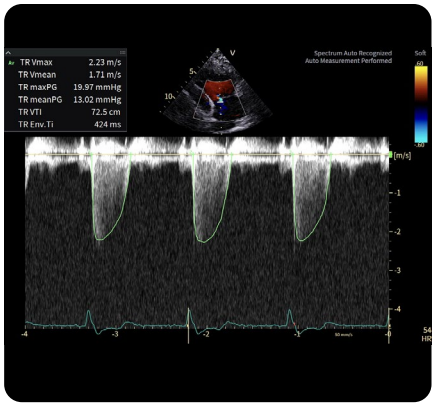
14) Assessment of TR mechanism and severity



Radiant*flow*



4D Dynamic Slices



Auto Doppler

Overall feedback

- Excellent image quality with improved spatial and temporal resolution of 4D images
- High sensitivity to detect small color jets
- Ability to appreciate fine anatomic details on intracavitary structures that are relevant for HCM diagnosis and management
- Efficient integration of 2D/4D/Doppler capabilities, transducers, echo techniques, and display modalities for in-depth anatomic and functional assessment and to address all the clinical questions

Prof. Denisa Muraru is a paid consultant for GE HealthCare and was compensated for participation in this article. The statements by Prof. Denisa Muraru described here are based on her own opinions and on results that were achieved in her unique setting. Since there is no “typical” hospital/clinical setting and many variables exist, i.e. hospital size, case mix, staff expertise, etc. there can be no guarantee that others will achieve the same results.

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