Cardiac MRI Improves Diagnostic Accuracy And Characterization In Children With Cardiomyopathy

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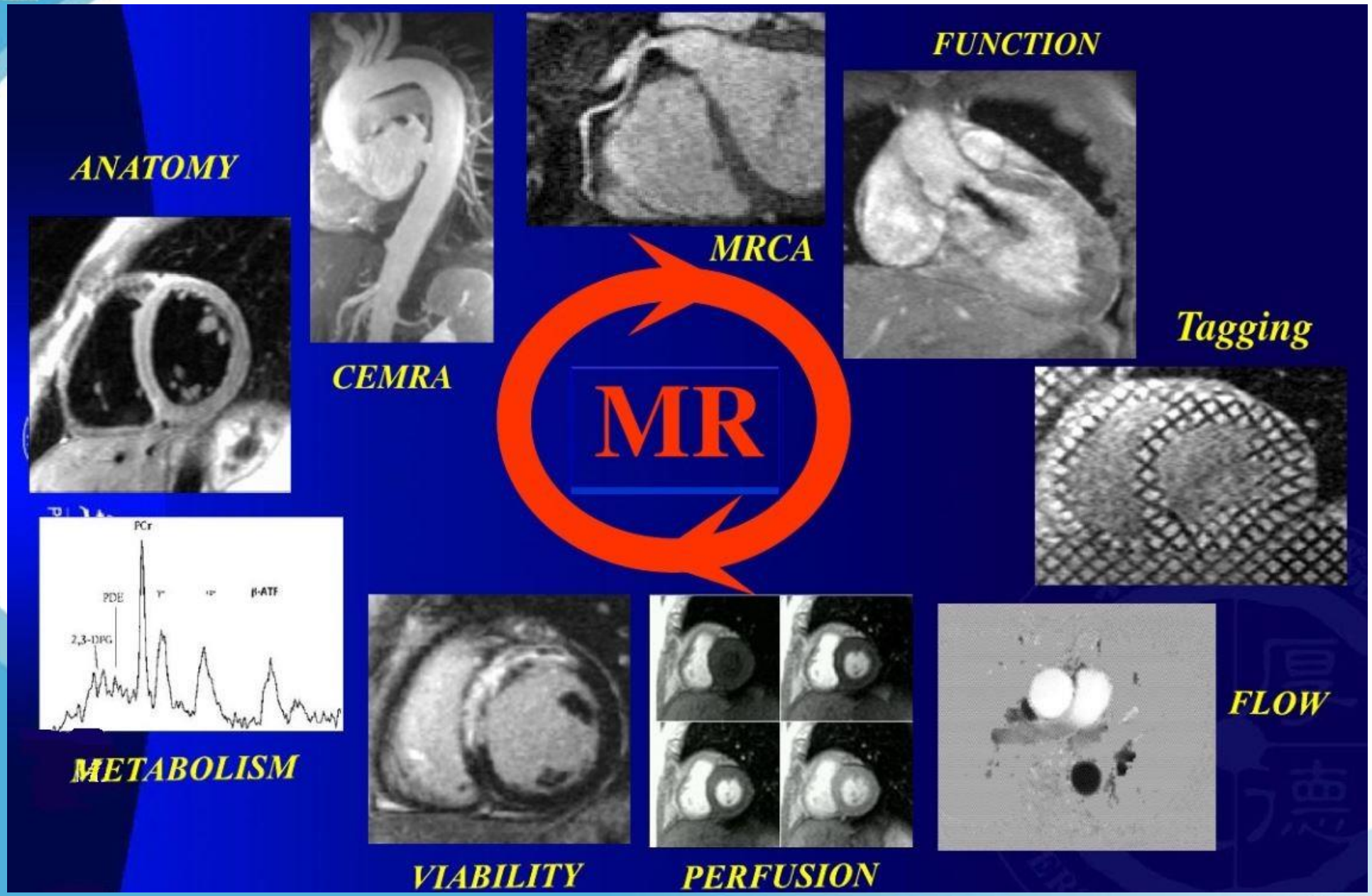
INTRODUCTION

- ✓ Recent advances in cardiac magnetic resonance imaging (cMRI) have made this scan an important tool for evaluating heart disease.
- ✓ The objectives of this study were to evaluate the role of cMRI in the diagnosis of children cardiomyopathy.
- ✓ Cardiomyopathies are common cardiac disorders seen in pediatric patients with a poor prognosis.

WHY MRI?

- High soft-tissue contract
- Availability of a large FOV
- Multiplanar acquisition capability
- Excellent spatial and temporal resolution
- Lack of ionizing radiation
- Non-invasiveness
- Wide range of cardiovascular applications
- Anatomic and functional diagnosis

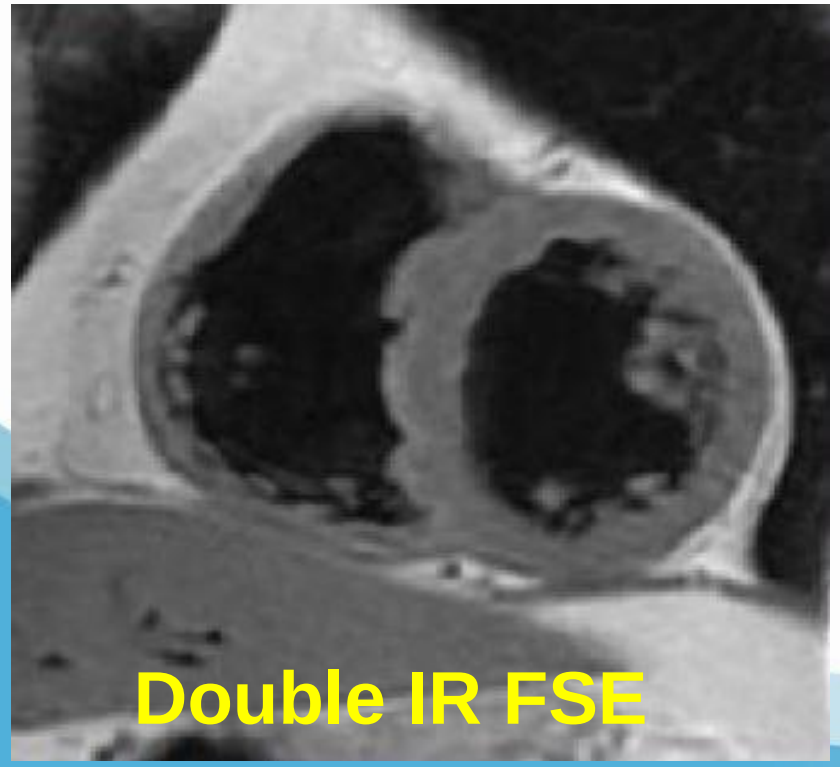


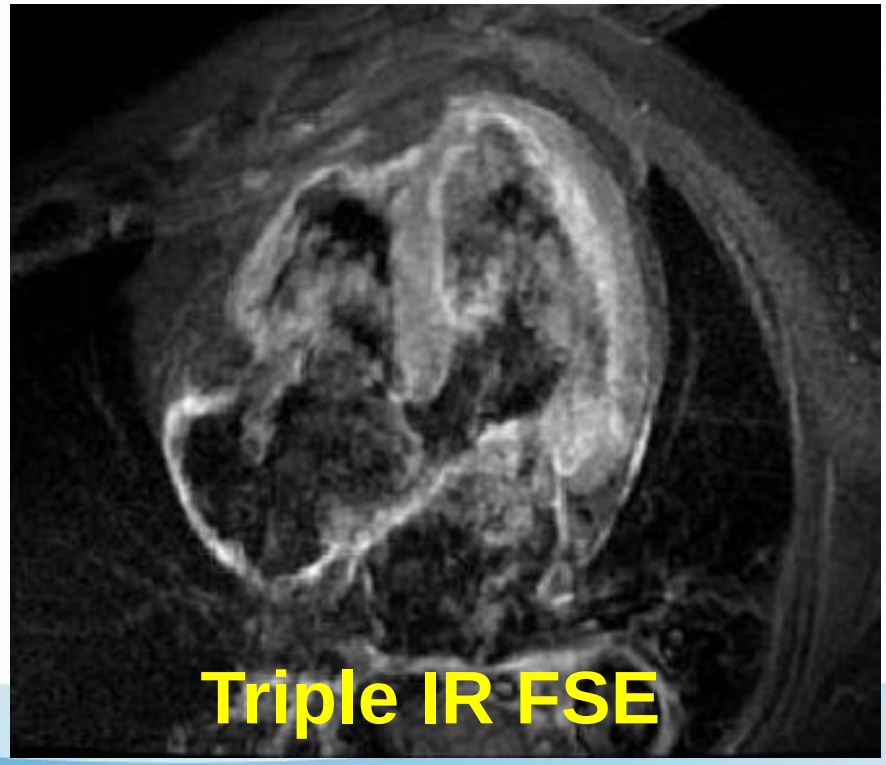
PULSE SEQUENCES

- Black blood – anatomy
  - Spin echo (SE)
- Bright blood – dynamic and angiography
  - Gradient Echo (GE)
- Phase contrast (PC) – quantify flow
- Delayed enhancement – infarct/inflammation/infiltration
  - 2D SSFP with IR prep
- Gadolinium assisted MRA – angiography
  - 3D fast spoiled GE

Black Blood

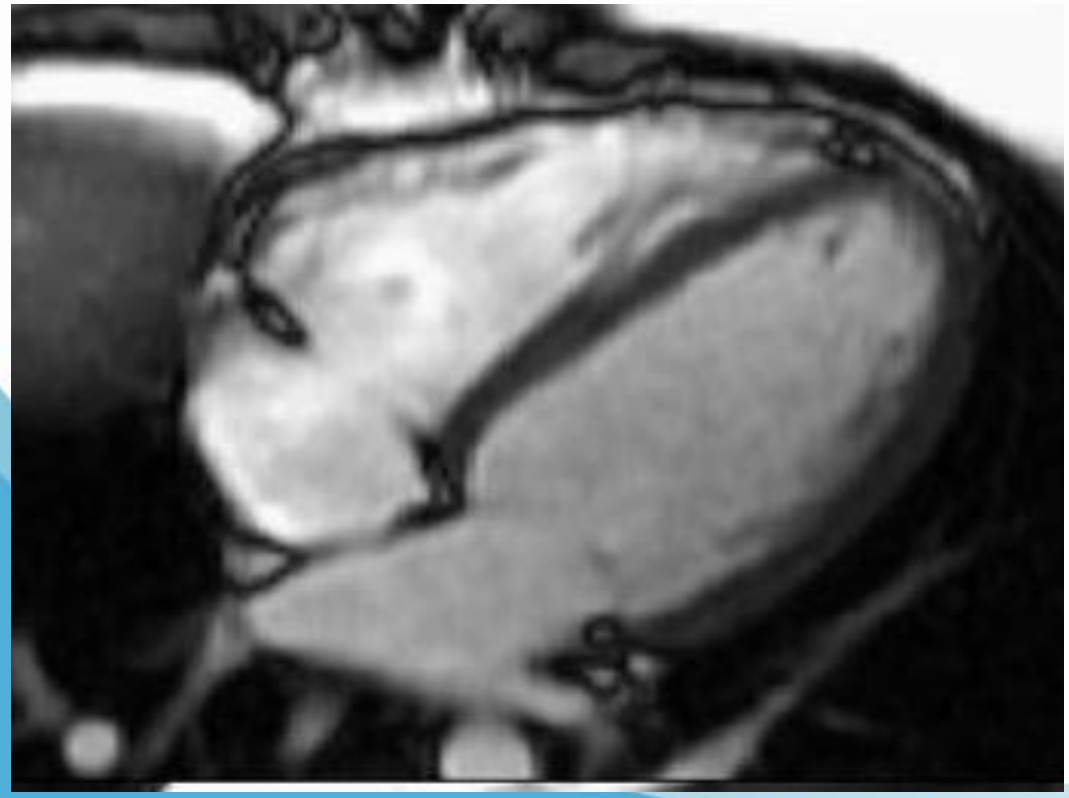
- Black-blood images are produced with MR pulse sequences that null signal from flowing blood for better visualization of cardiac anatomy.

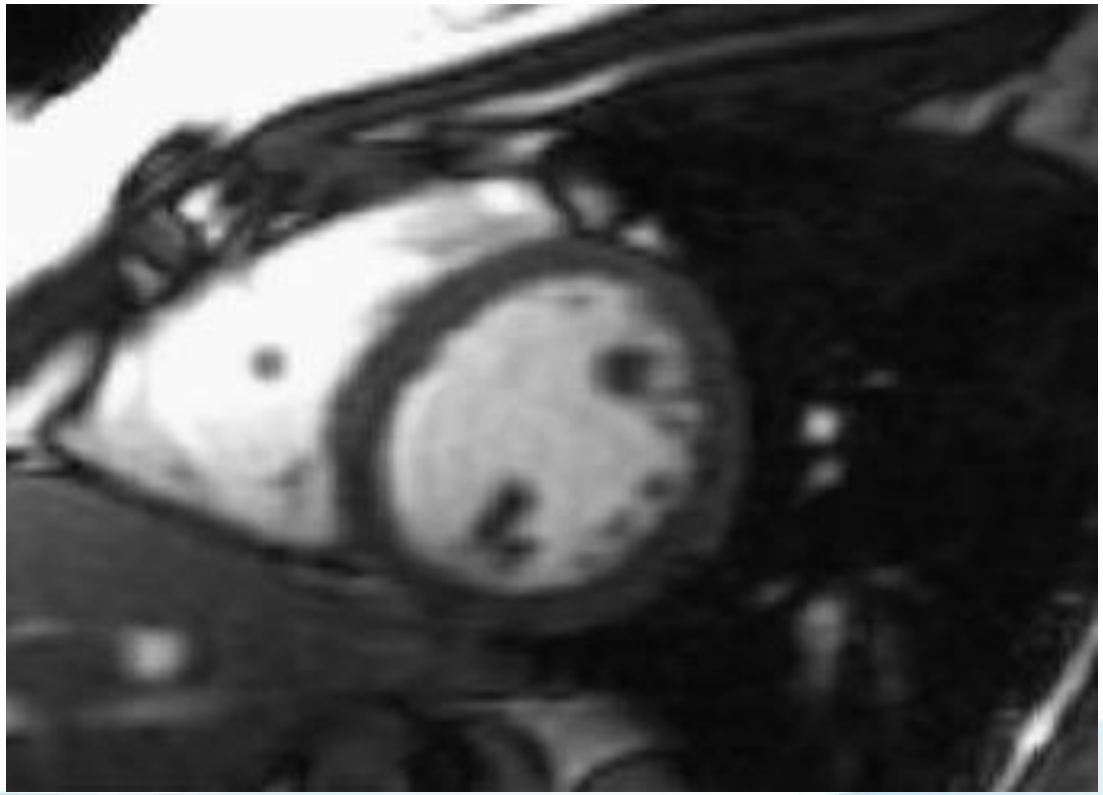




Bright Blood

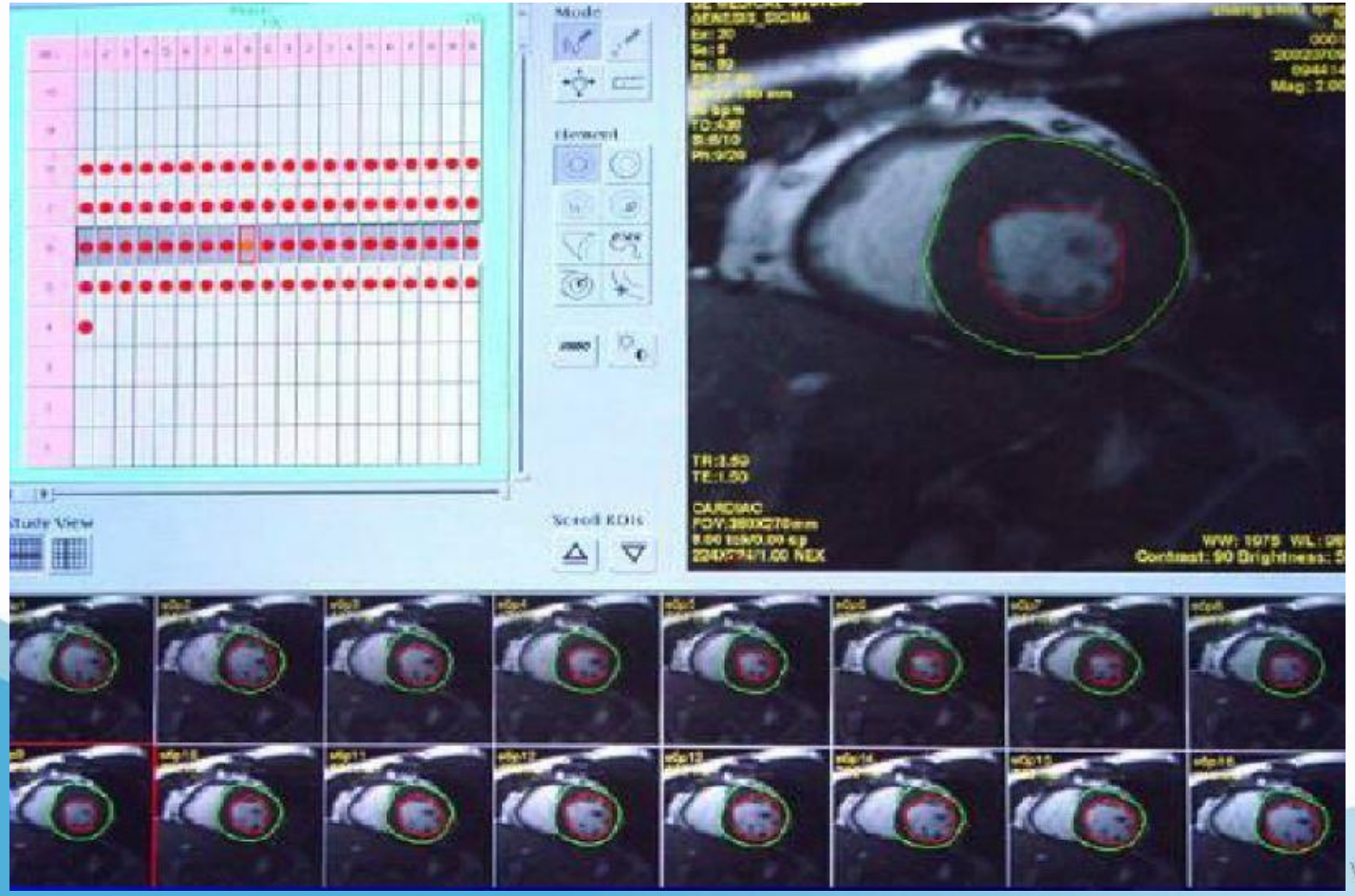
- High signal intensity of fast-flowing blood





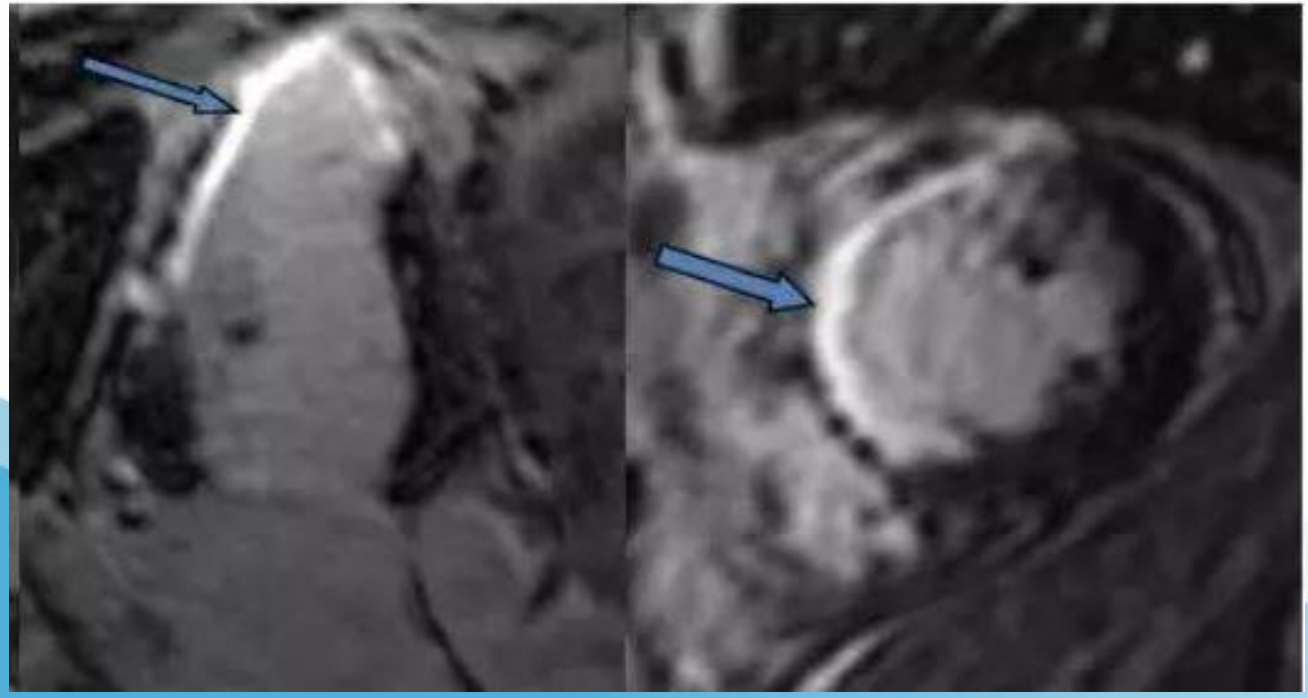
Cine

- Typically used to evaluate cardiac function

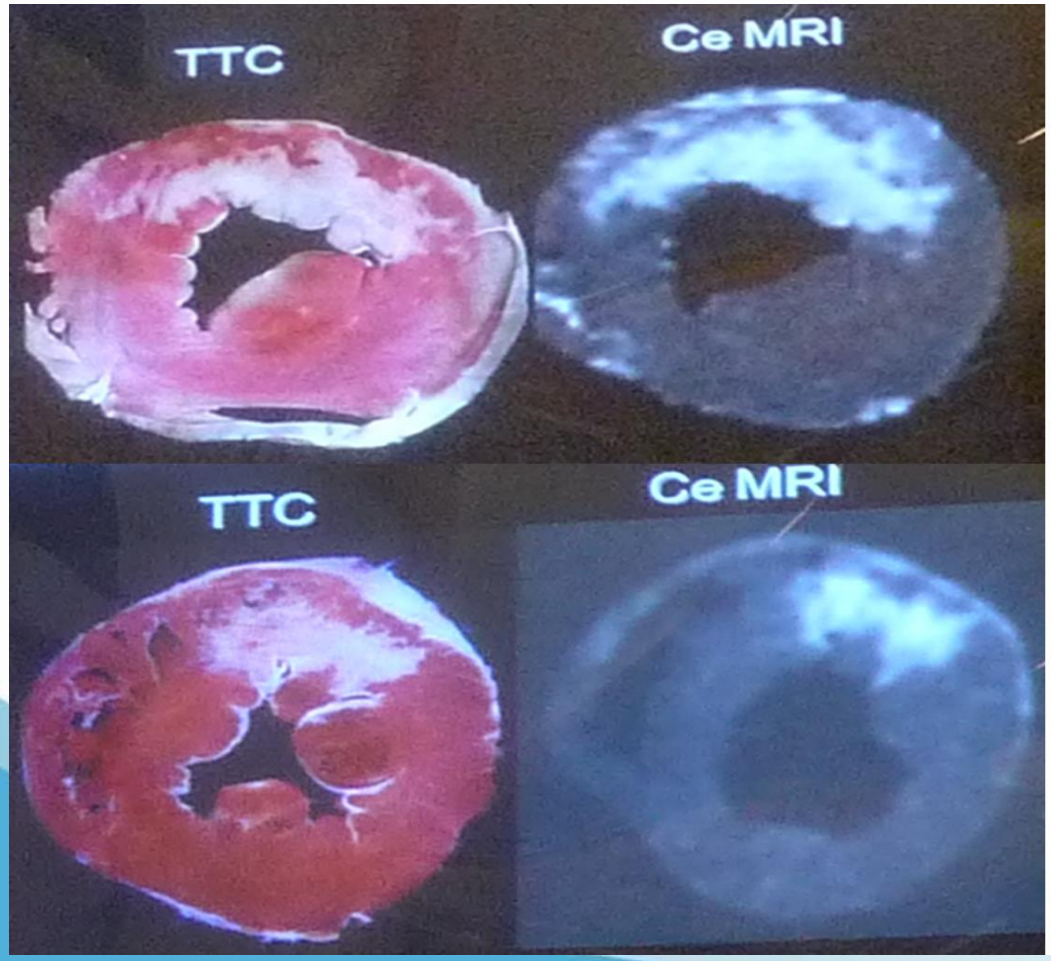


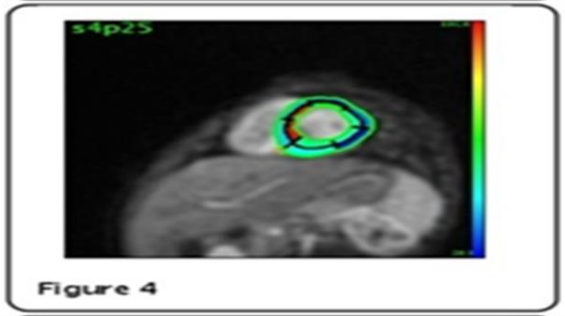
Delayed enhancement Imaging

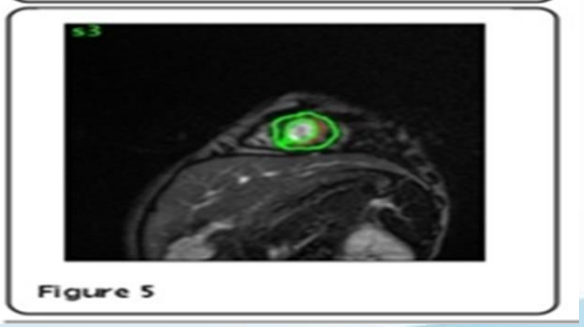
- The most accurate method for diagnosing myocardial infarction or nonischemic cardiomyopathies.
- Delayed-enhancement imaging typically is performed using a inversion-recovery gradient-echo (GRE) pulse sequence, with the inversion time to null the signal from normal myocardium.



17 segment heart model







CARDIOMYOPATHIES

- ✓ The cardiomyopathies are diseases of the myocardium associated with cardiac dysfunction and are subdivided on the basis of morphology into hypertrophic, dilated, restrictive and ARVC.
- ✓ cMRI is rapidly becoming very useful in the assessment of morphological changes as well as functional alterations in pediatric patients with cardiomyopathy.

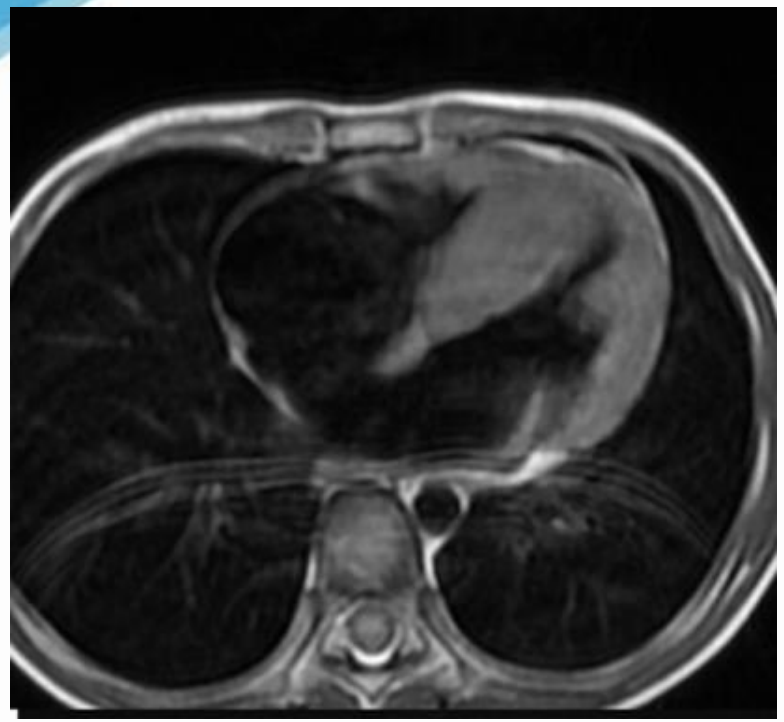
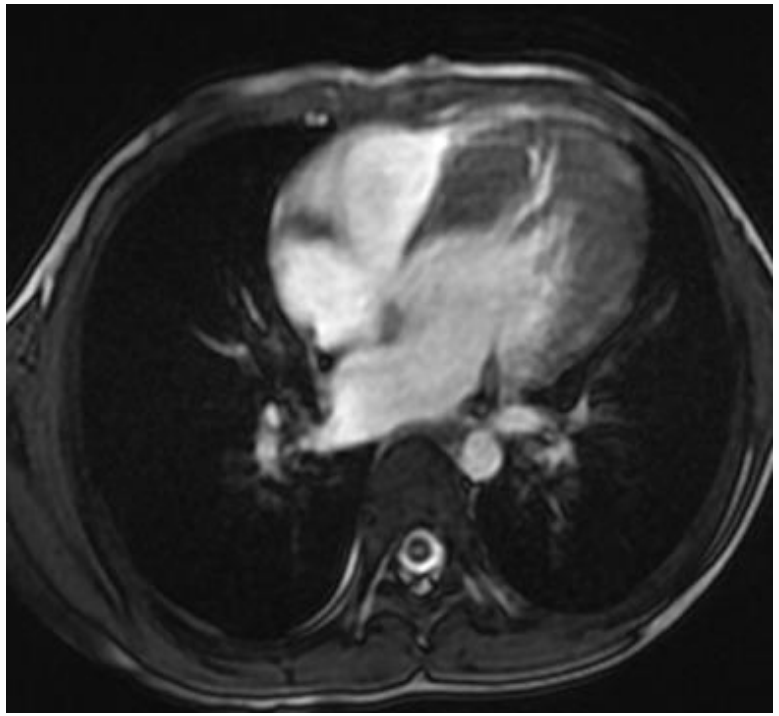
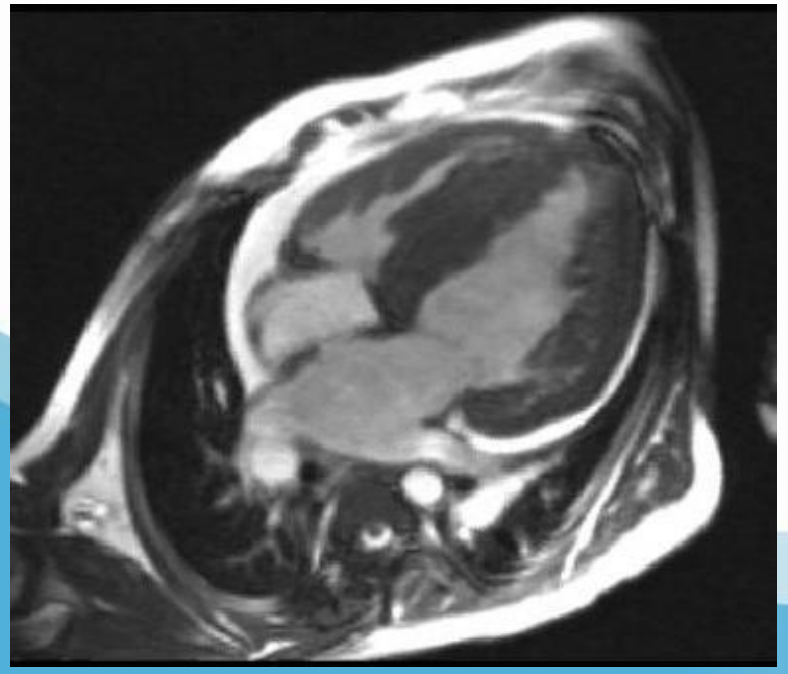
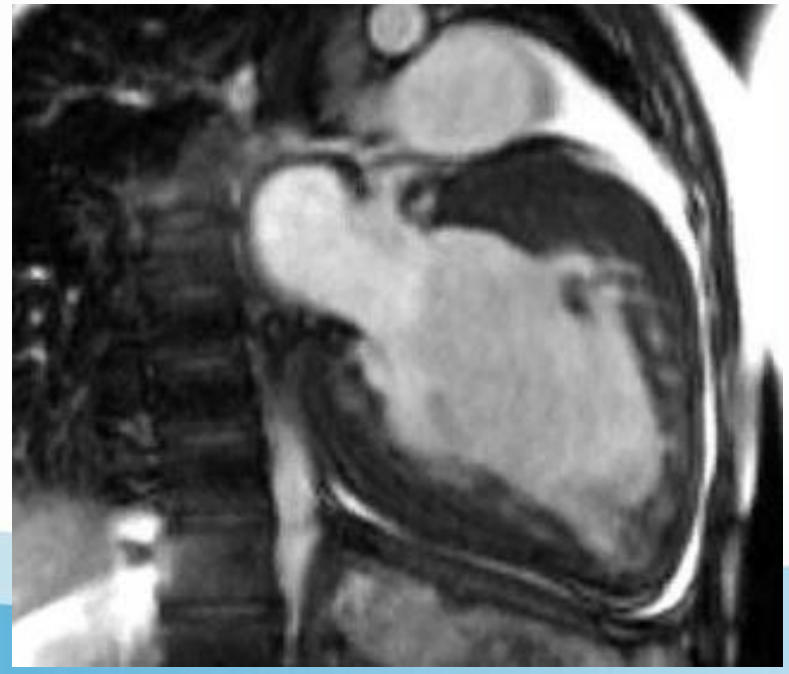
Hypertrophic Cardiomyopathy

Characteristic imaging findings include:

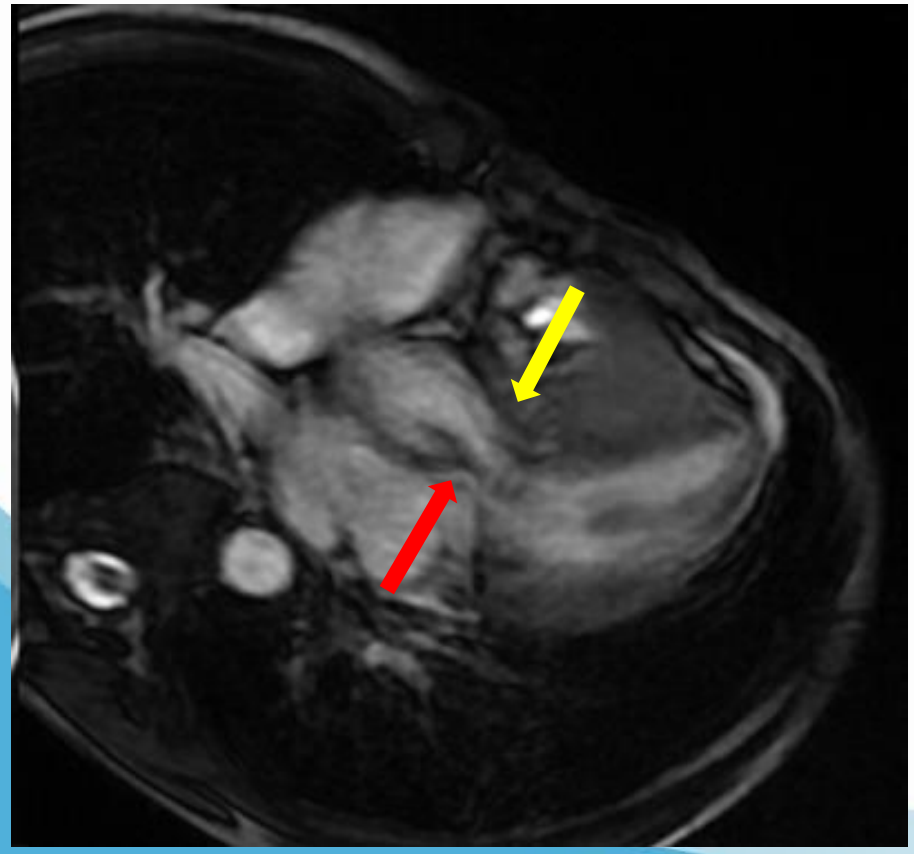
- LV wall hypertrophy (more often asymmetric) resulting in a small LV cavity that may be obliterated in severe cases.

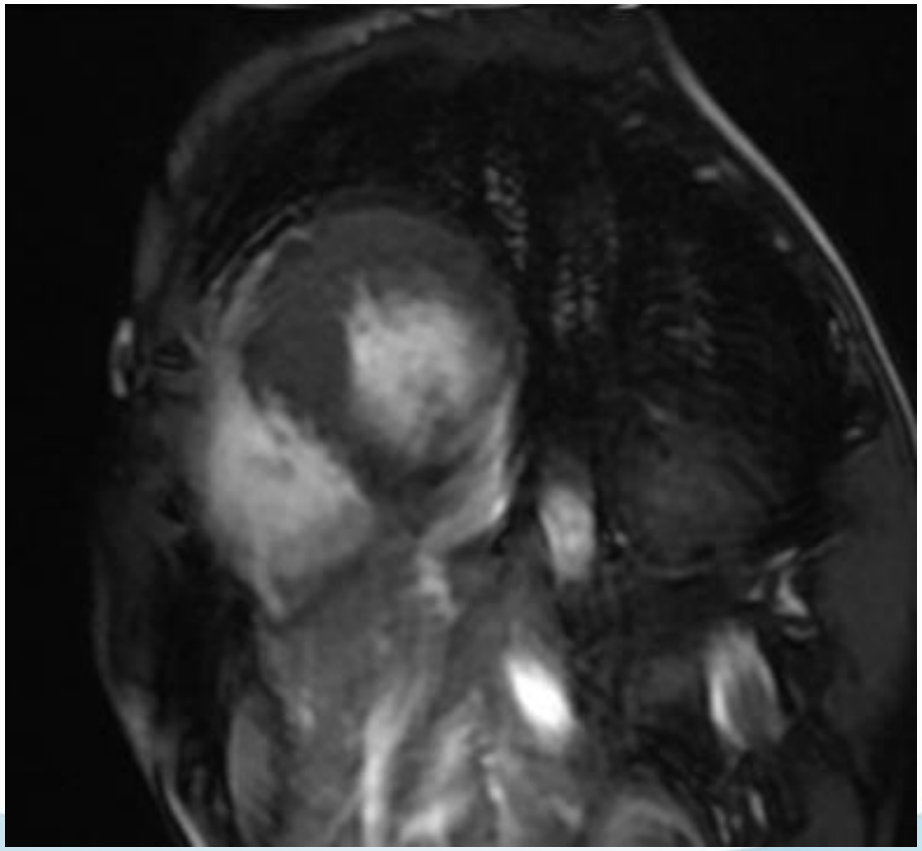
  Asymmetric: end diastolic thickness of septum to postero-lateral wall > 1.5

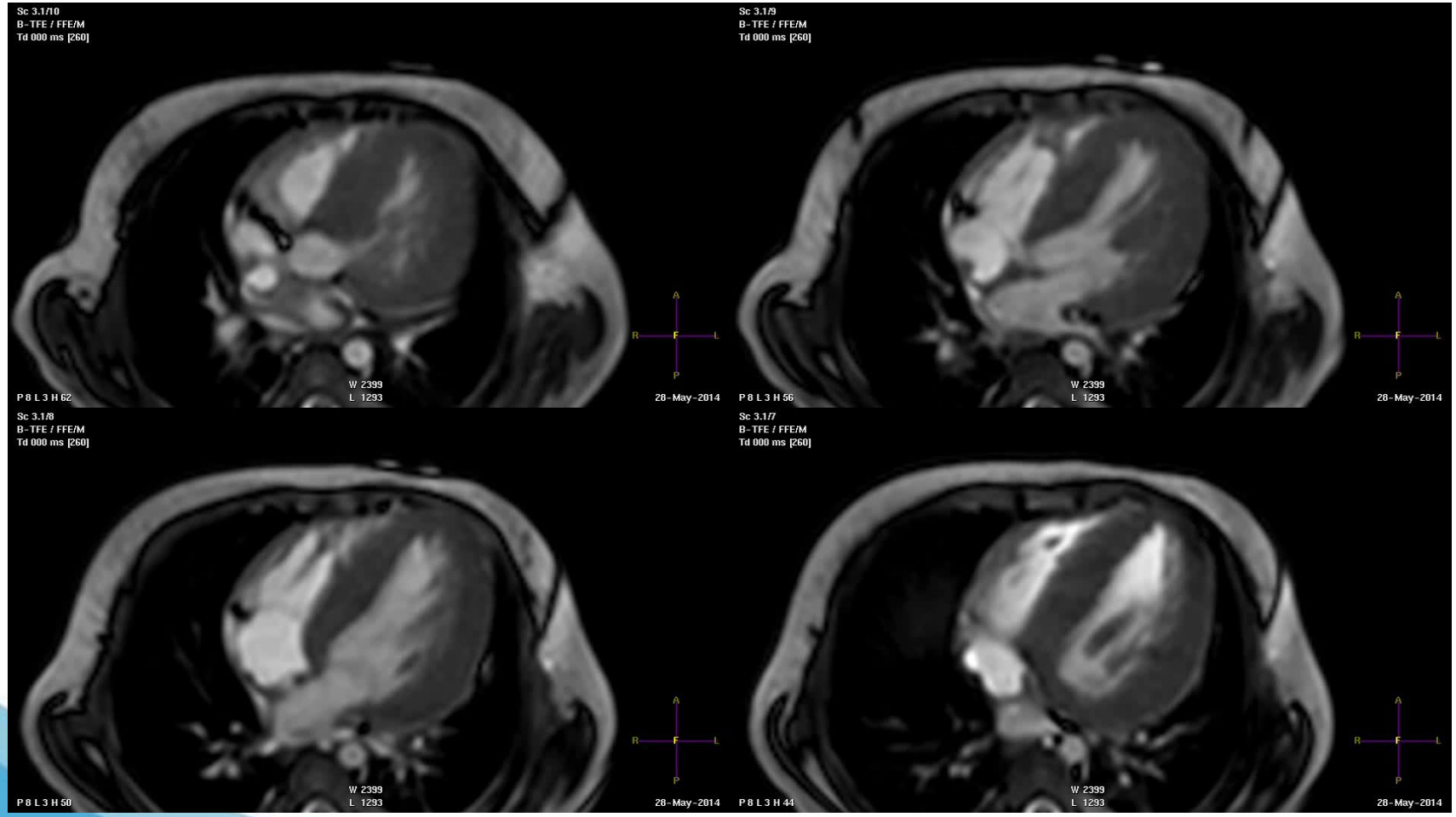
- Diastolic dysfunction with reduced LV compliance
- Relatively preserved systolic function.

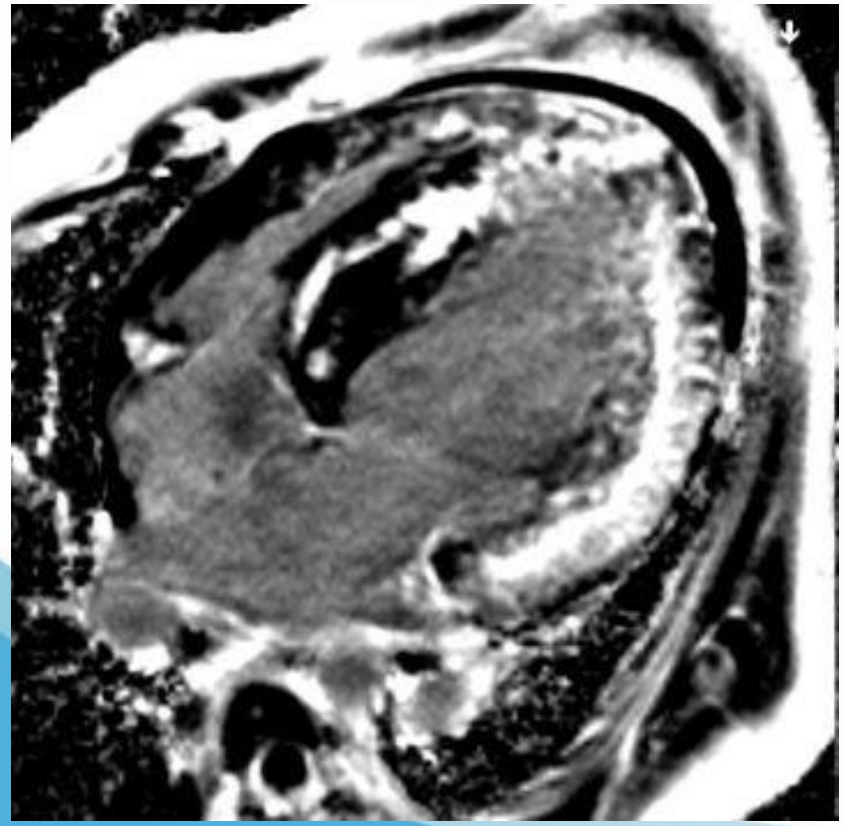
Classic findings in HCM with obstructive features include asymmetric septal hypertrophy and systolic anterior motion of the anterior mitral leaflet.

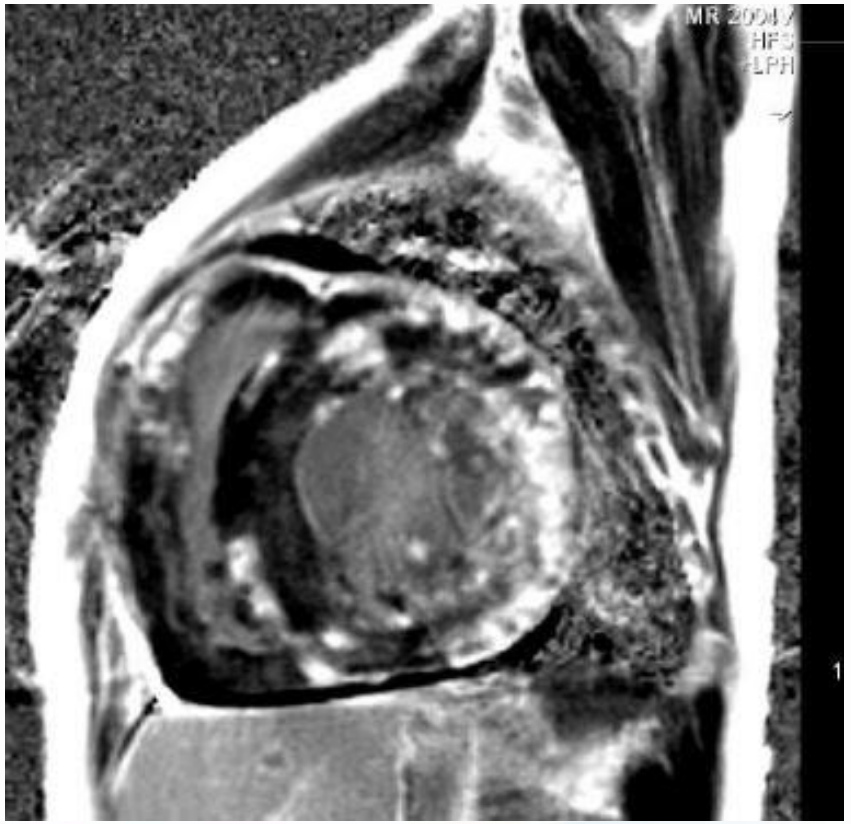






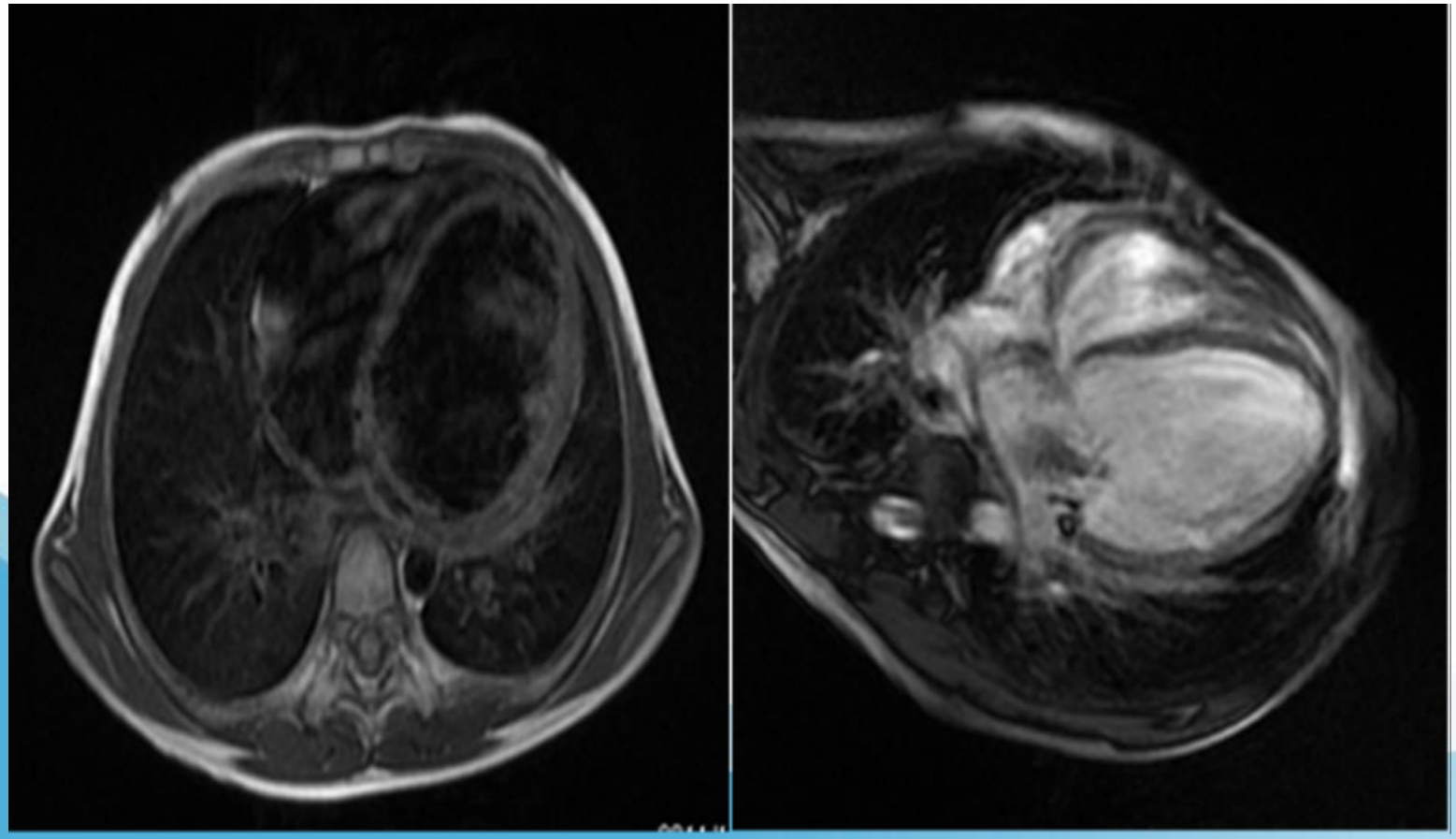
- Late enhancement image shows the enhancement of the hypertrophic myocardium.

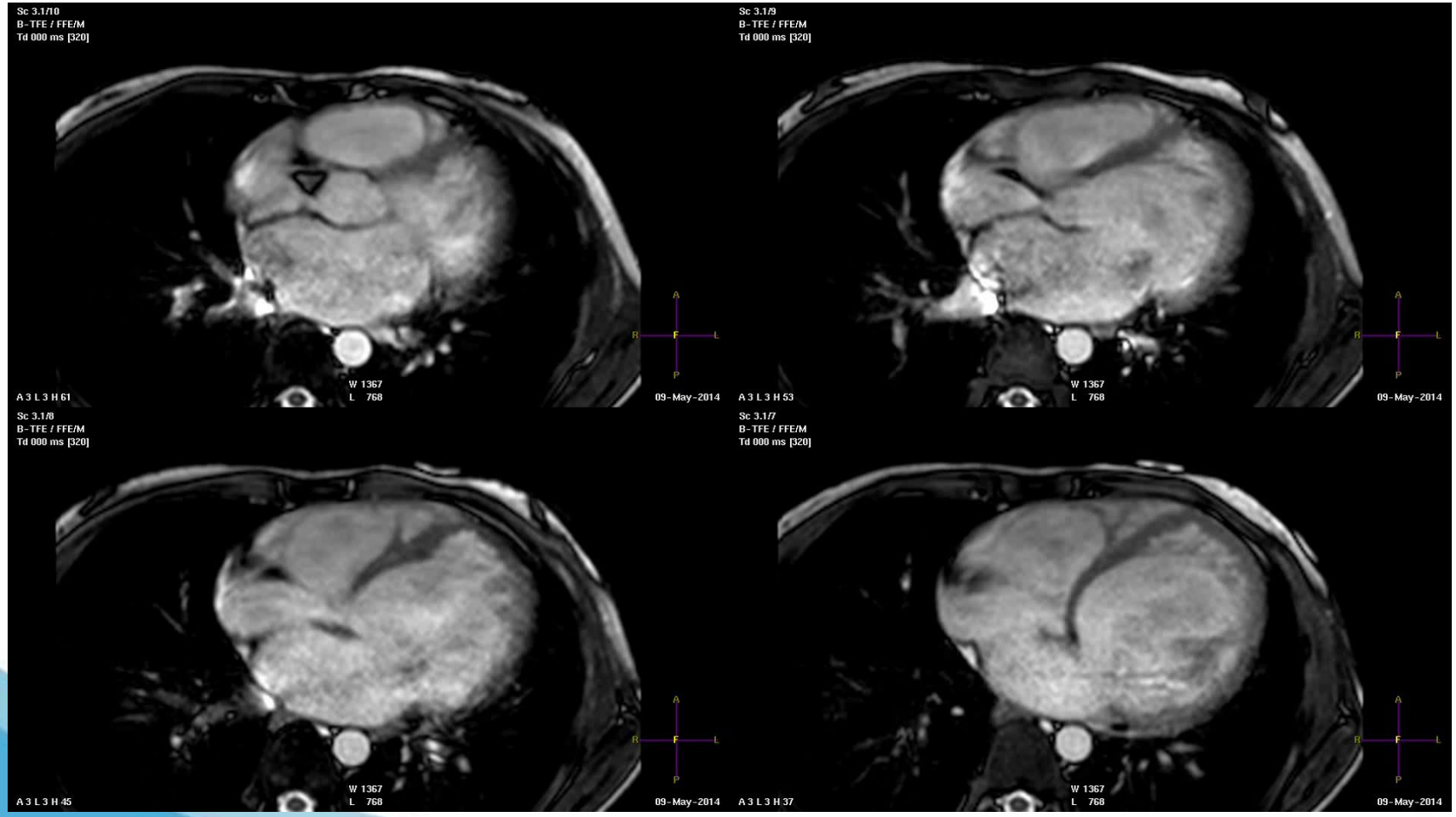




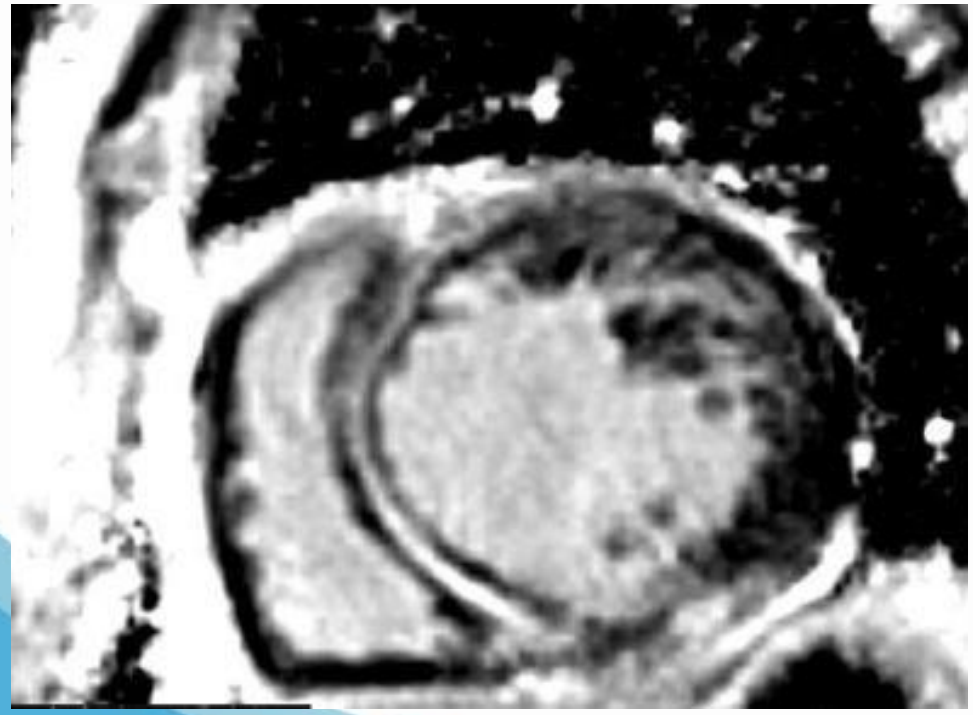
Dilated Cardiomyopathy

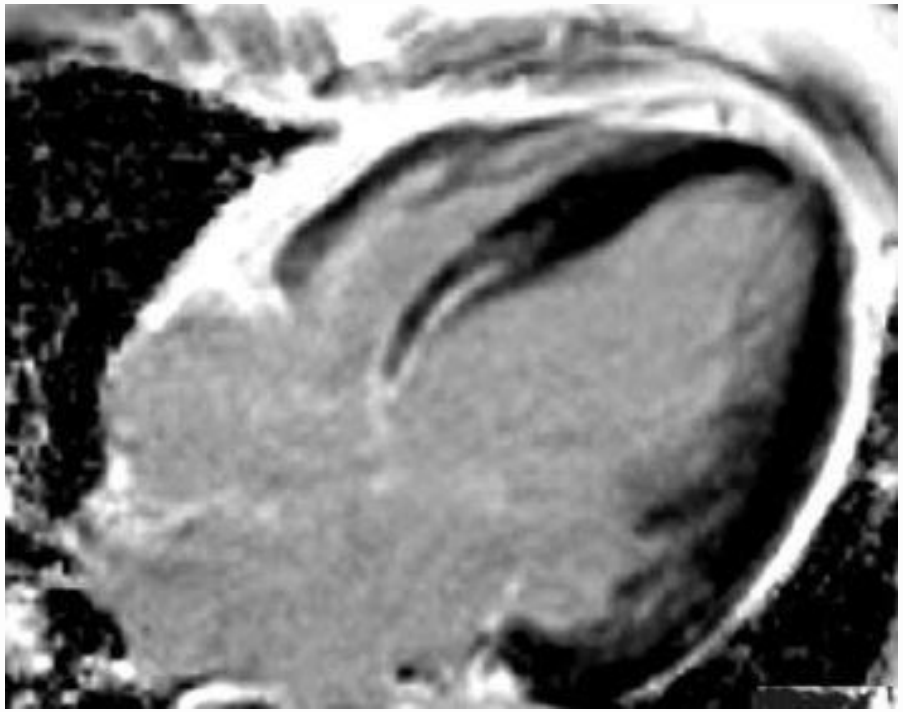
- Left ventricular dilatation with systolic dysfunction.
- Ventricles can have normal or thin walls but always have increased cavitary volumes and low ejection fractions (EFs).





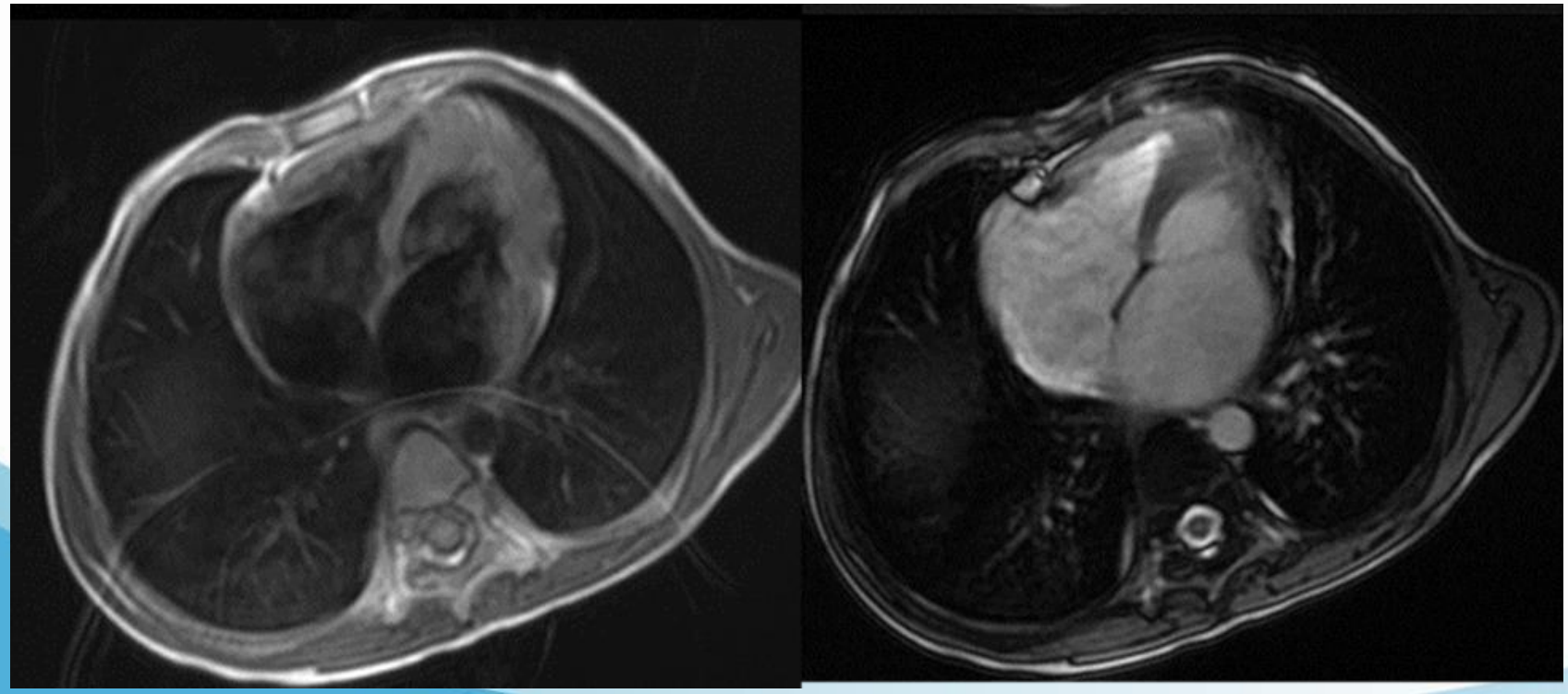
- Late enhancement is absent/faint and limited to mesocardial layers, usually septal/diffuse.

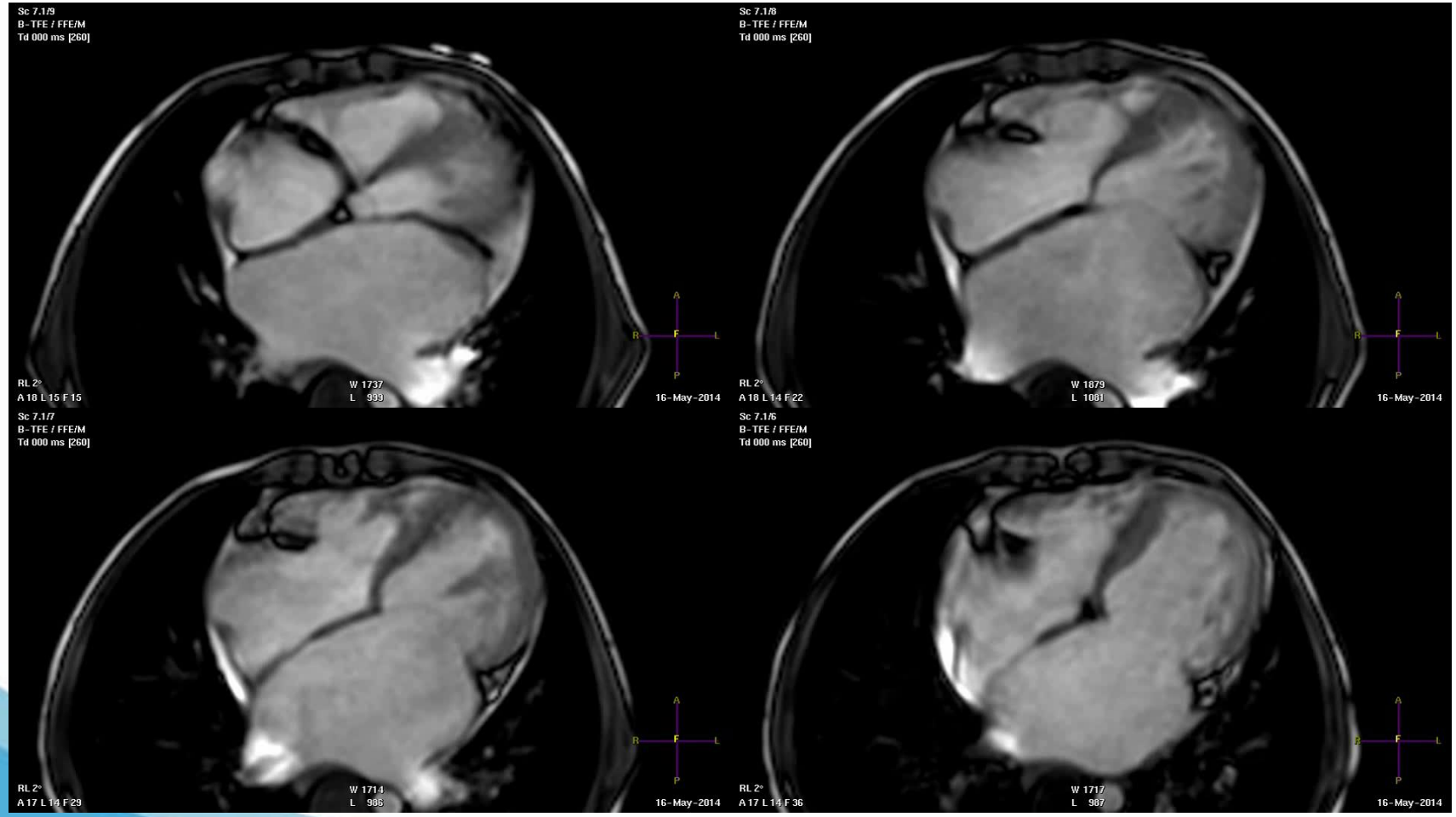




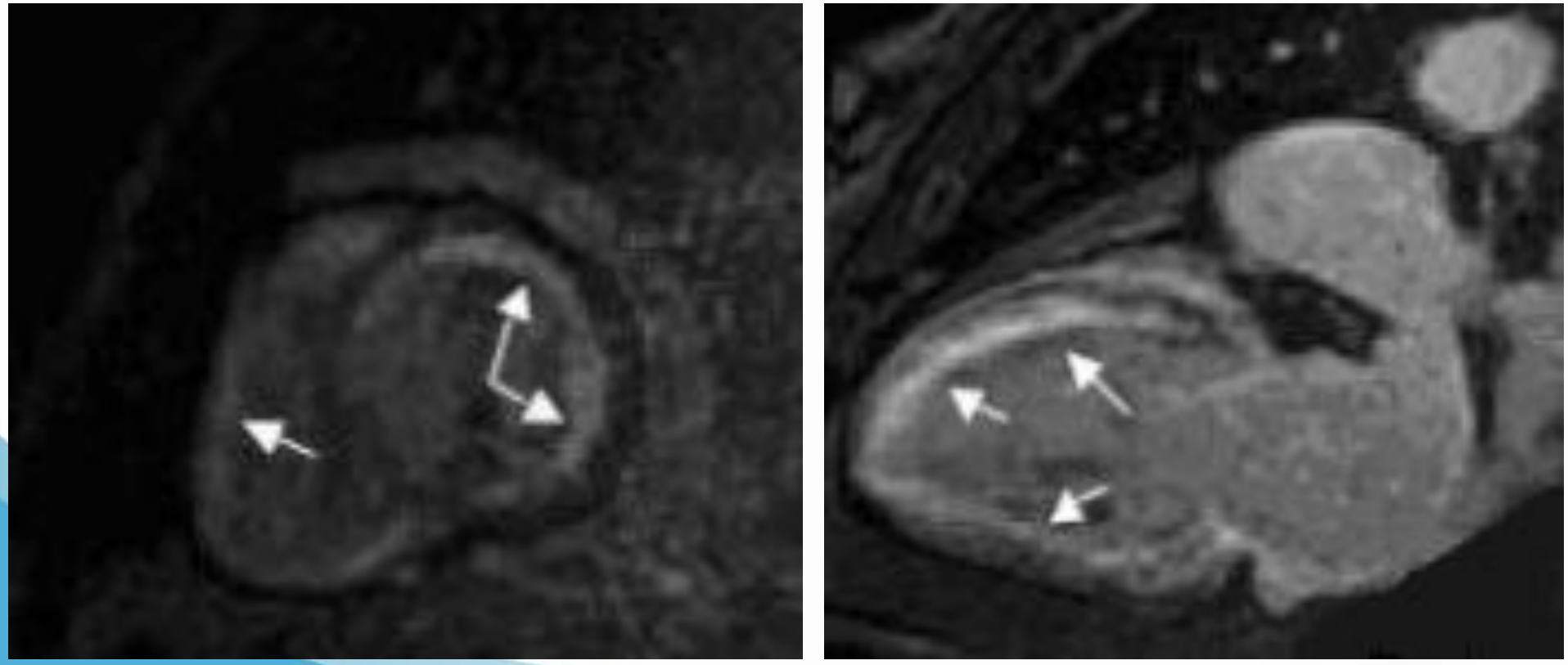
Restrictive cardiomyopathy

- Reduced ventricular filling and diastolic volume, leading to atrial dilatation and venous stasis, usually with preserved systolic function.





- Late enhancement imaging is useful in secondary restrictive cardiomyopathy, such as cardiac amyloidosis.



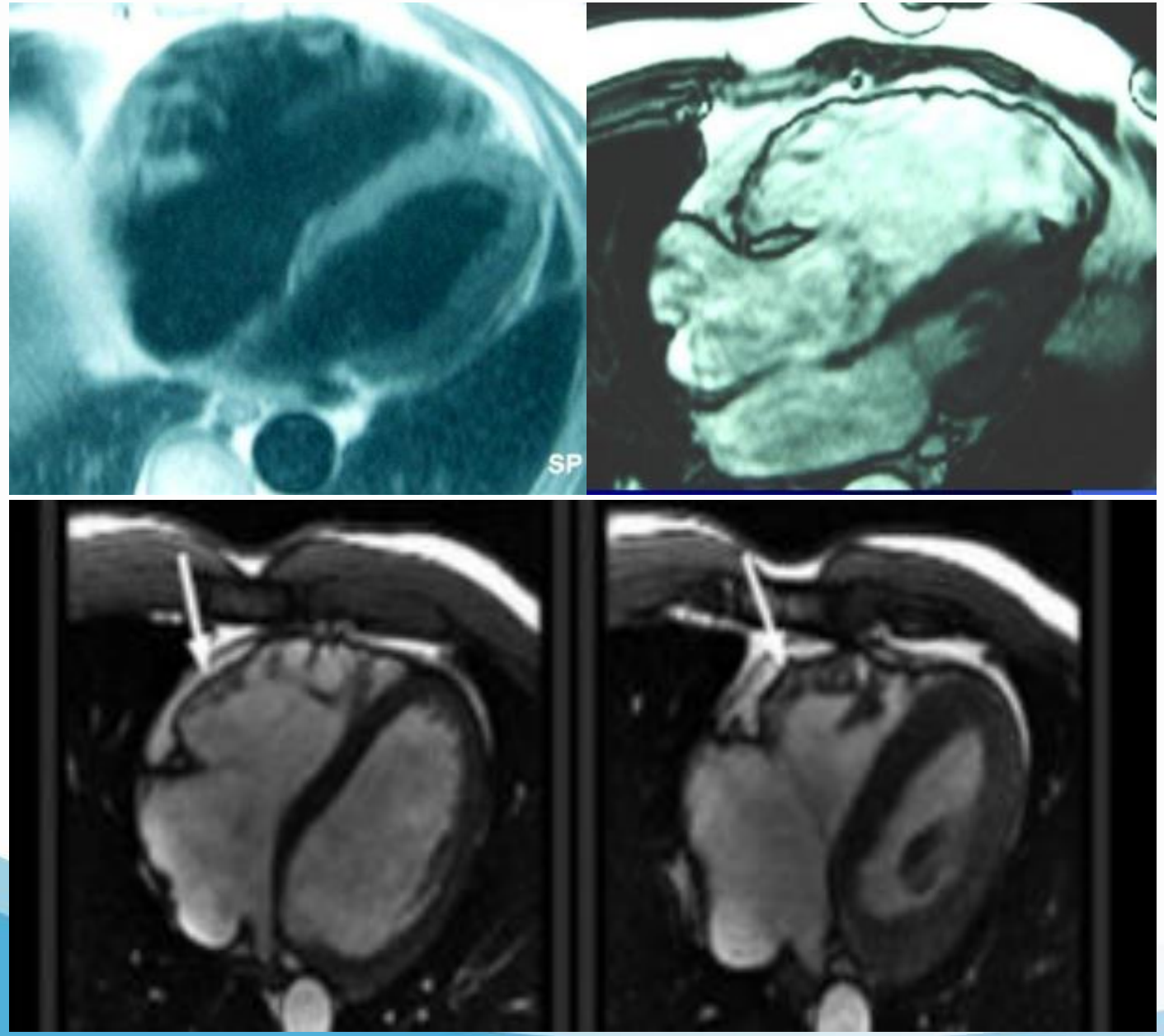
	HYPERTROPHIC	DILATED	RESTRICTIVE
Dysfunction	Impaired diastolic function	Systolic dysfunction	Diastolic dysfunction
Black blood images	Increased LV wall thickness (>15mm) Asymmetric: septal to posterolateral wall thickness ratio >1.5	Enlarged cardiac chambers with normal/thin myocardial walls	Enlarged atria with normal or small sized ventricles. RV enlarges if pulm HTN co-exists. Normal pericardial thickness
Cine images	Normal LV EDV, Normal or reduced LV ESV, normal or increased LVEF And allows the evaluation of outflow tract obstruction	LV hypokinesia and increased volumes (end diastolic and end systolic) , decreased LV stroke volume and LVEF	Allow assessment of the altered diastolic ventricular filling
Late enhancement	Fundamental role in risk stratification in patients	Ischemic vs non ischemic DCM	Useful in secondary restrictive cardiomyopathy

Arrhythmogenic right ventricular cardiomyopathy (ARVC)

- Major criteria demonstrated by MRI are:

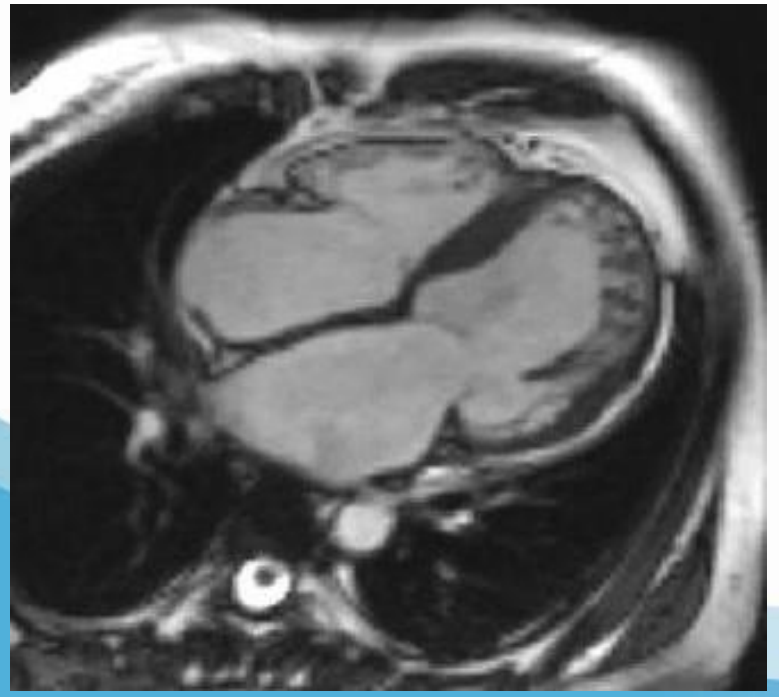
1. localized aneurysms
2. severe global or segmental dilatation of the right ventricle
3. global systolic dysfunction

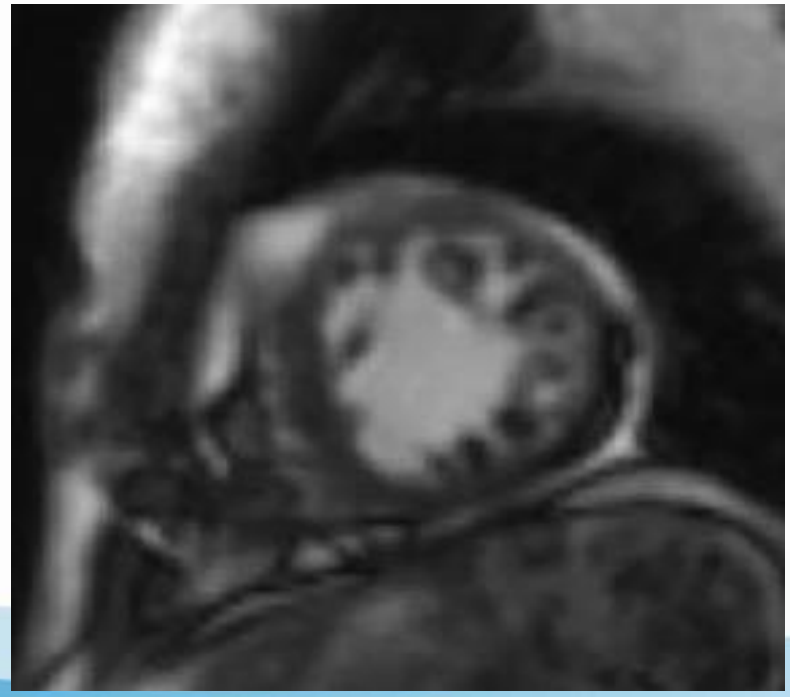
- Hallmark = fibrofatty replacement of the RV myocardium

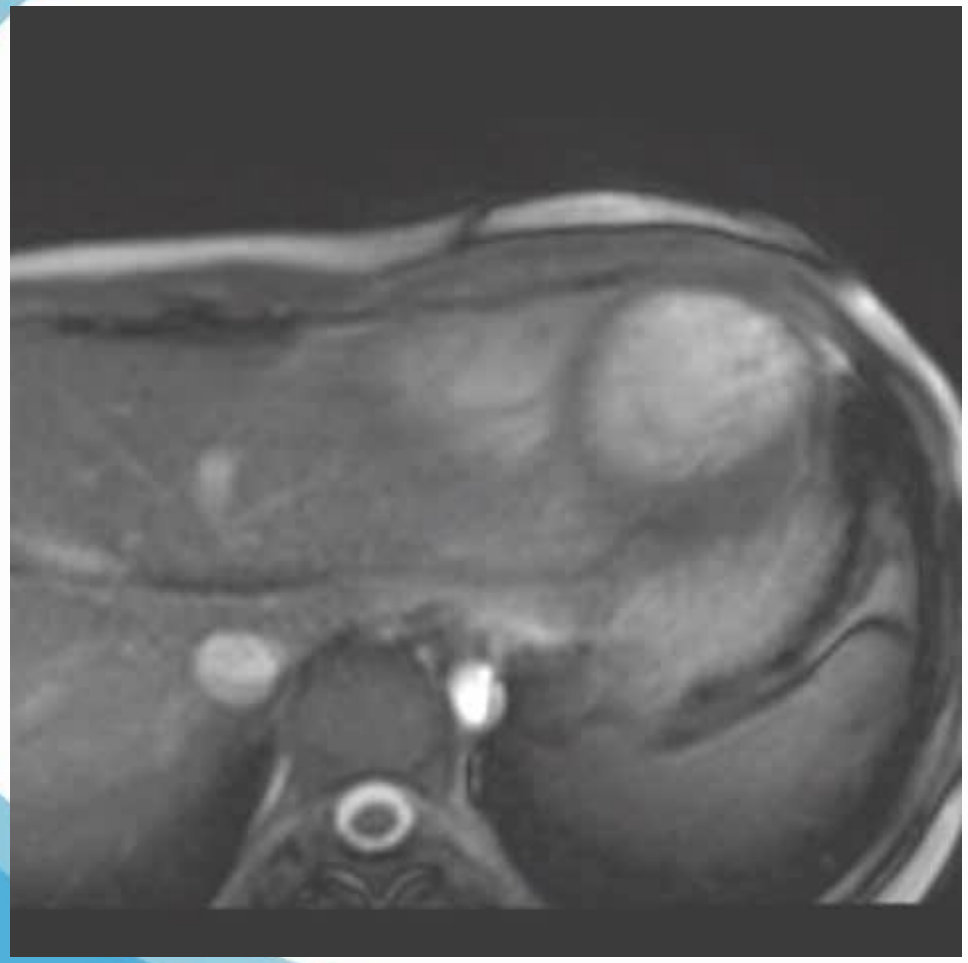


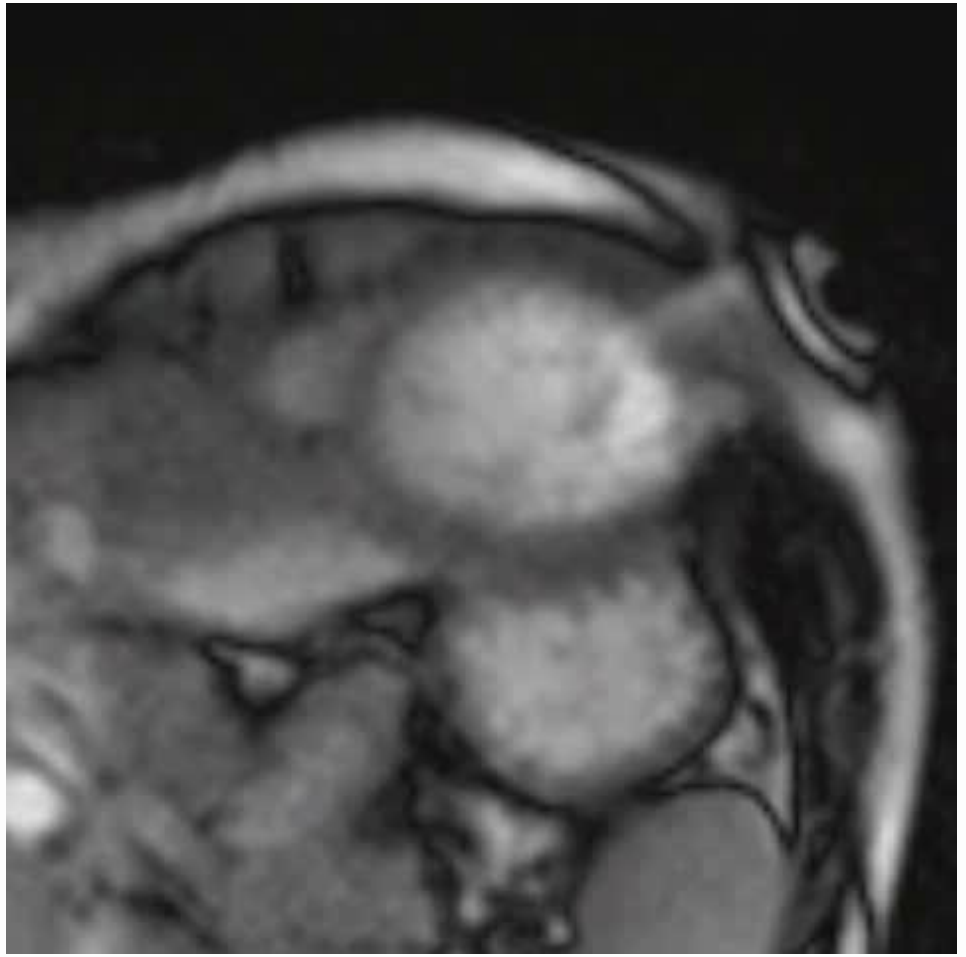
Left ventricular noncompaction (LVNC)

- There is persistence of trabeculation and deep recesses communicating with the ventricular cavity due to noncompaction.
- LV end-diastolic thickness of noncompacted : compacted ratio > 2.3.



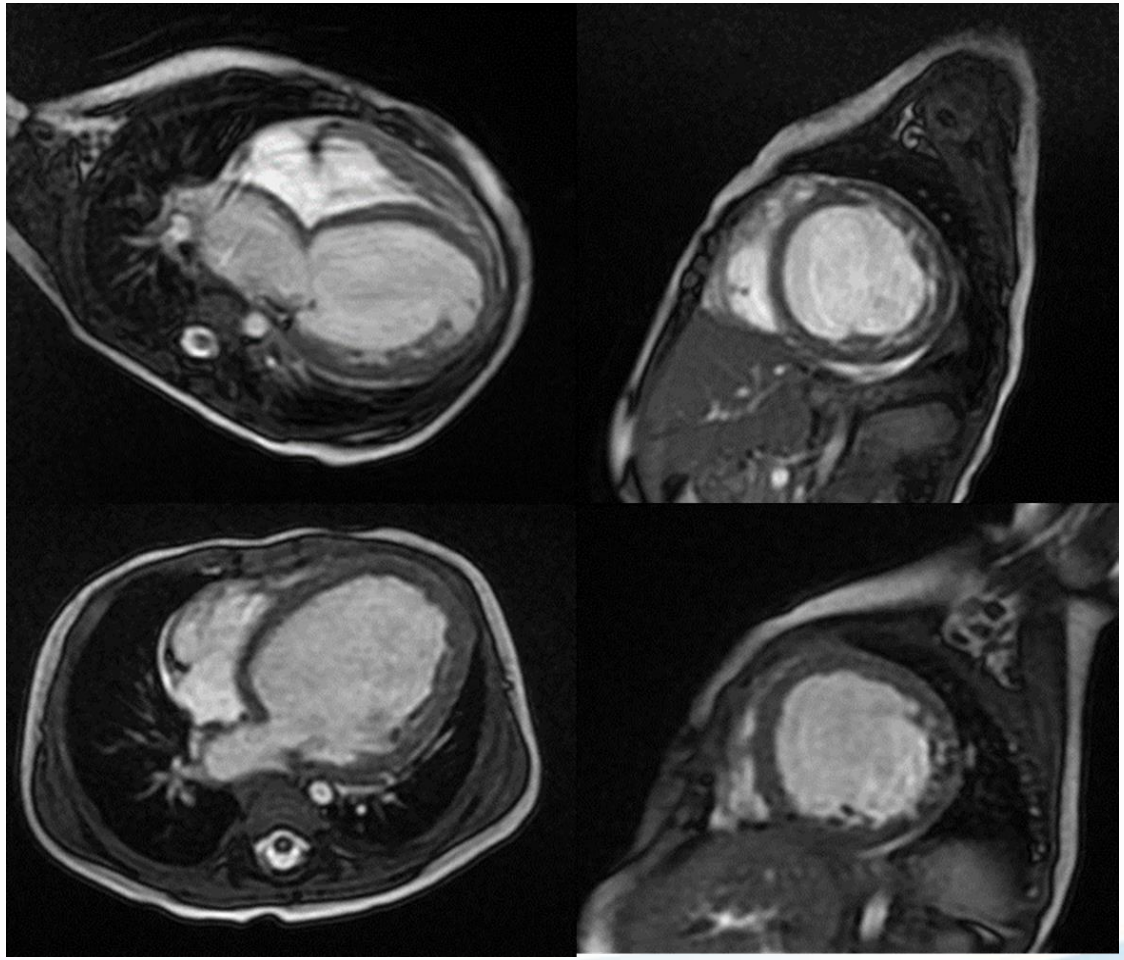




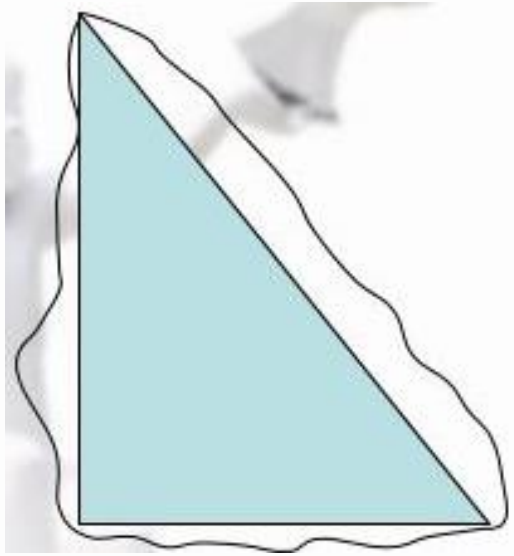


Endocardial fibroelastosis (EFE)

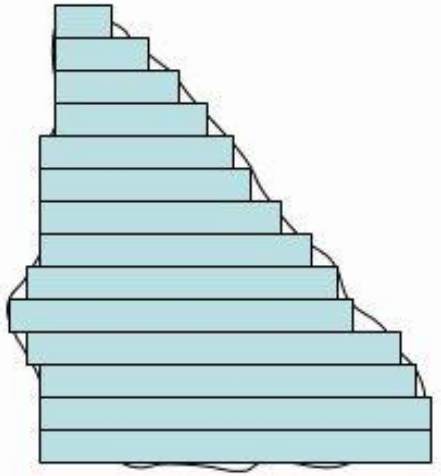
- cMRI can show Left ventricular dilatation with systolic dysfunction.
- A thickening within the muscular lining of the heart chambers due to an increase in the amount of supporting connective tissue (inelastic collagen) and elastic fibers.



cMRI vs echocardiography



Echo



cMRI

Yuting Zhang, Jie Tian, et al. Measurements in Pediatric Patients with Cardiomyopathies: Comparison of Cardiac Magnetic Resonance Imaging and Echocardiography. Cardiology 2015;131:245–250

CONCLUSION

- CMR can:
- Provide invaluable anatomical and functional cardiovascular assessment, and improve diagnostic accuracy and characterization in children with cardiomyopathy.

- CMR cannot:
- Replace echocardiography.


Thank You !