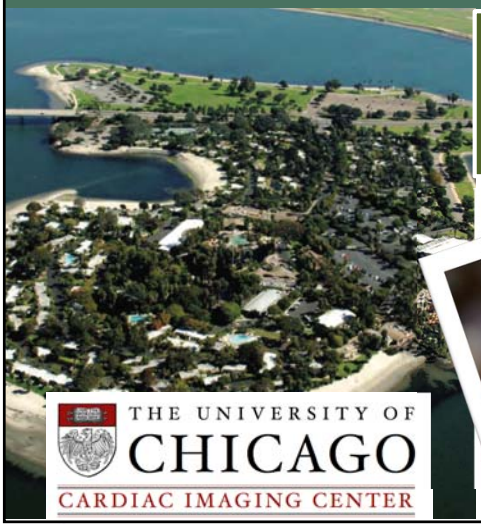
State-of-the-Art ECHOCARDIOGRAPHY

31st ANNUAL

Case Studies Athlete's Heart



THE UNIVERSITY OF CHICAGO
CARDIAC IMAGING CENTER

Roberto M Lang, MD

Athlete's Heart

Subjects diagnosed with athlete's heart commonly display signs that would usually indicate a heart condition if they were seen in a non-athlete:

- **Bradycardia**
- **Cardiomegaly**
- **Cardiac Hypertrophy**

Athlete's Heart

Long term athletic training results in

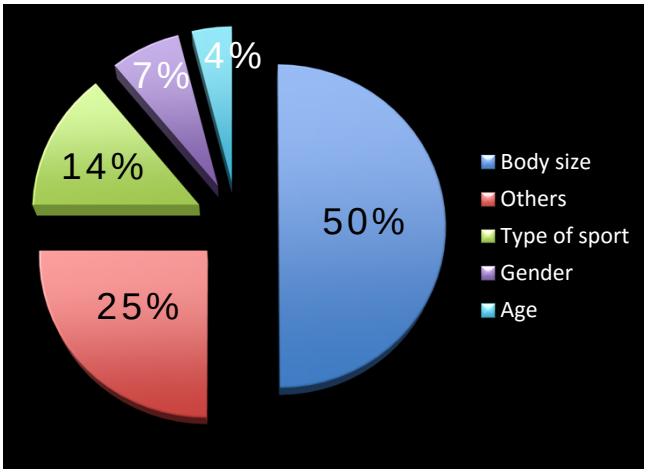
- ↑ LV EDD
- ↑ LV WT
- ↑ LV Mass
- ↑ maximal O2 consumption

Increase extraction of oxygen, reduced blood lactate levels, maximal AV oxygen difference

LVEDD

- Large group (1309) elite athletes from 38 disciplines
- Women: **(mean 48 mm)**
- Men: **(mean 55mm)**
- **LVEDD was between 60 and 70 mm in 14%**
- Larger LVEDD seenin athletes with higher body mass and in those participating in endurance sports (cycling, canoeing)

Impact of different clinical variables on LV EDD cavity dimensions in a large population of male and female elite athletes.



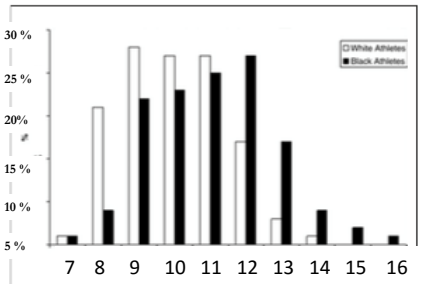
Maron B J , Pelliccia A Circulation 2006;114:1633-1644

Upper limits of Physiologic Cardiac Hypertrophy in Highly Trained Elite Athletes

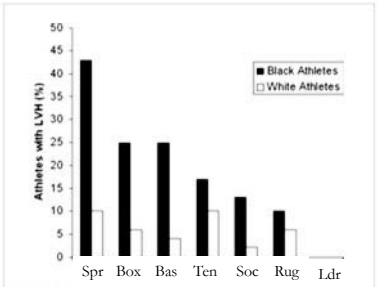
- **Athletes with a WT of 13-16 mm and a non-dilated LV cavity = Suspect primary pathologic hypertrophy**
- **All athletes with walls ≥ 13 mm also have enlarged LVED (55 to 63 mm)**

Differences in LVH between black and white athletes

Distribution of LV WT

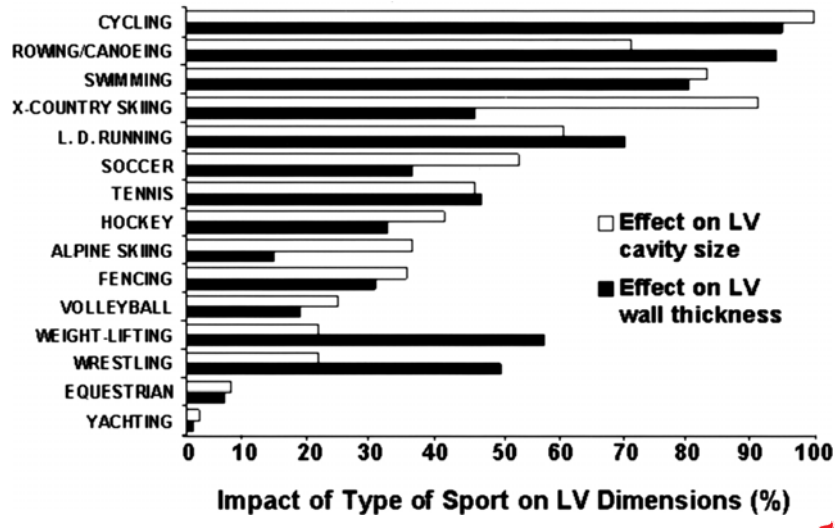


LVH in relation to Sporting disciplines



A minority of black athletes exhibit a LV WT ≥ 15 mm compared with none of the white athletes

Effect of specific sports training on LV cavity dimension or wall thickness in elite athletes, representing 27 different sporting disciplines.

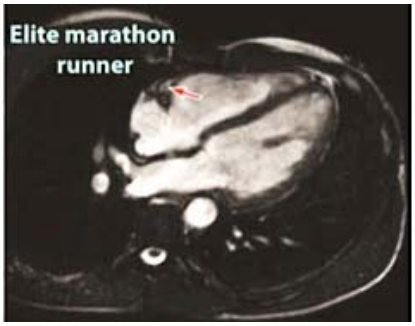


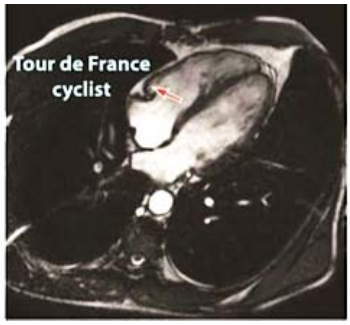
Maron B J , Pelliccia A Circulation 2006;114:1633-1644

American Heart Association
Learn and Live

RV Modeling in Olympic Athletes

- RV modeling occurs in Olympic athletes, with male sex endurance practice playing the major impact. A significant subset (up to 32%) of athletes exceeds the normal guideline limits

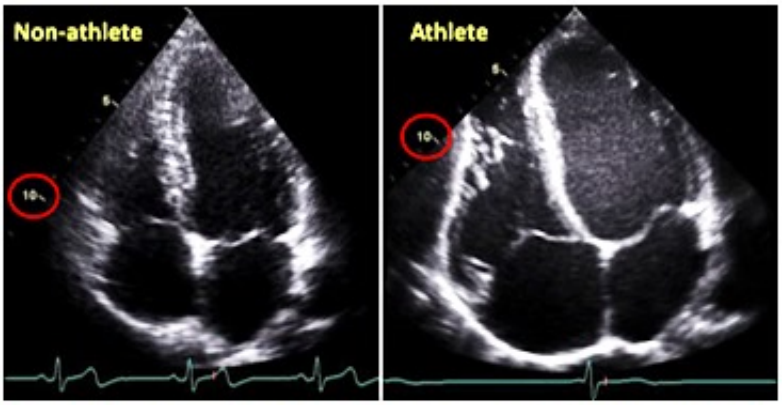




LV Systolic Function in the Athlete

23 y/o non athlete, LVEF 66%

23 y/o athlete, LVEF 51%



Most athletes have normal resting LVEF
Tour de France Athletes: 11% had a calculated LVEF of ≤ 52%

LV Systolic Function in the Athlete

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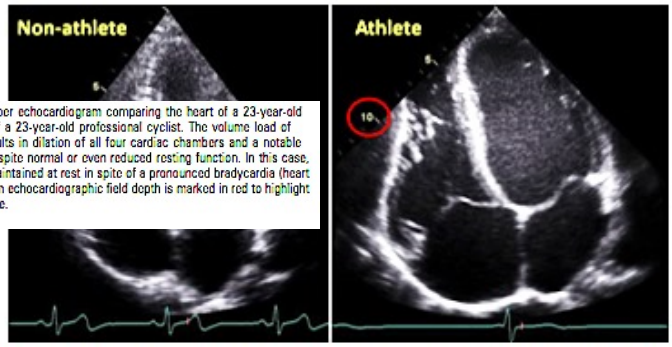
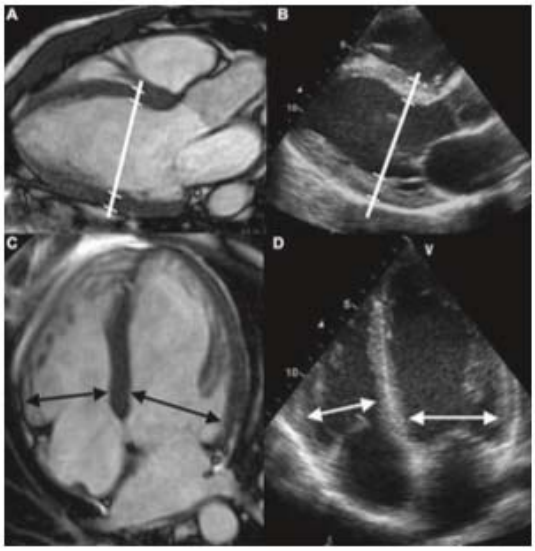


ure 1 Apical four chamber echocardiogram comparing the heart of a 23-year-old -athlete (left) with that of a 23-year-old professional cyclist. The volume load of durance sport training results in dilation of all four cardiac chambers and a notable rease in stroke volume despite normal or even reduced resting function. In this case, ormal cardiac output is maintained at rest in spite of a pronounced bradycardia (heart 28 beats/min). The 10 cm echocardiographic field depth is marked in red to highlight differences in cardiac size.

Most athletes have normal resting LVEF
Tour de France Athletes: 11% had a calculated LVEF of ≤ 52%

Understand the inter-technique differences



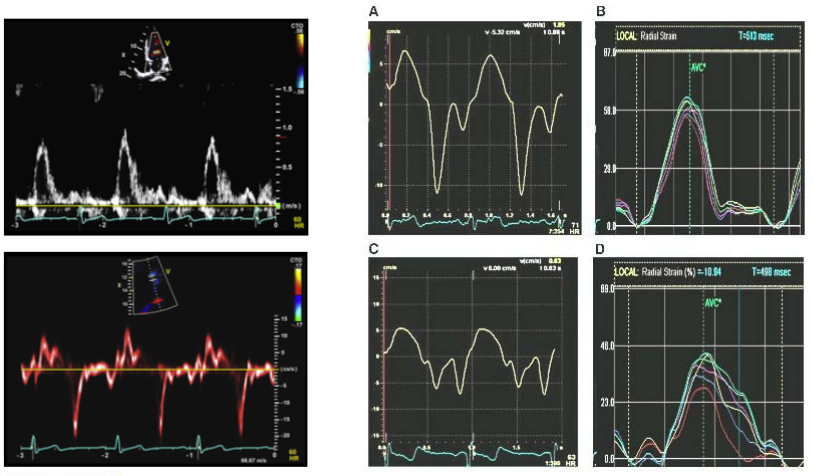
Septal WT = 11 mm
LV Post WT = 12 mm
LV ED = 66 mm

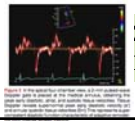
MRI: > Dimensions

Echo > Thickness

Septal WT = 14 mm
LV Post WT = 13 mm
LV ED = 54 mm

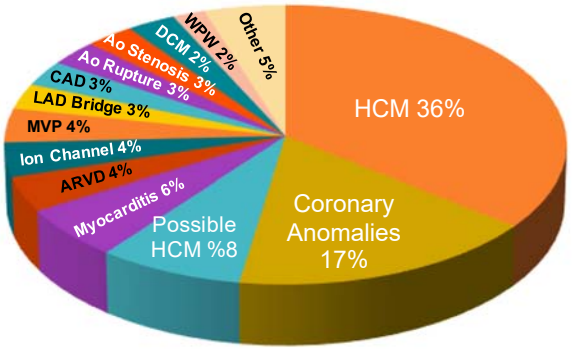
LV Diastolic Function in the Athlete





ndurance exercise training leads to enhanced early diastolic
lling, as assessed by the E wave and mitral annular velocities

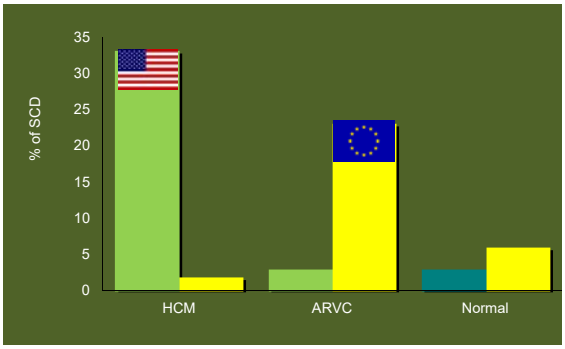
Cardiovascular causes of Sudden Death in Young Competitive Athletes



US National registry of 1866 Athlete Deaths

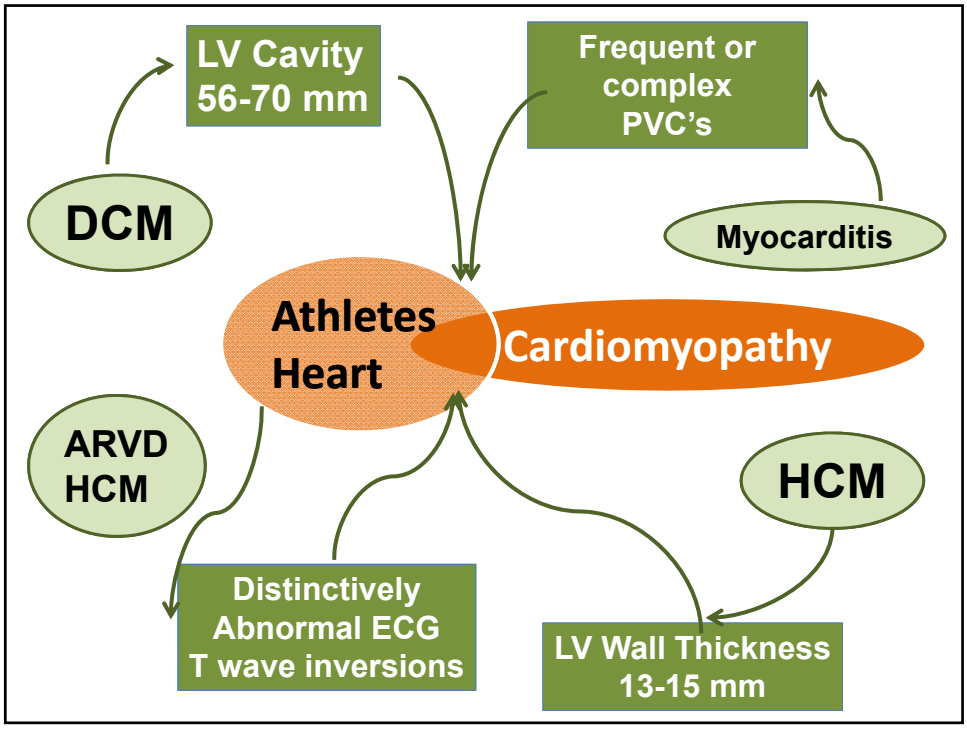
SCD (<40 y): Underlying Pathology

Athletes



	Country	Cases of SCD	n/100000/y
* Maron, 2003	US	387	0,5
Corrado, 2003	Italia	55	2,3

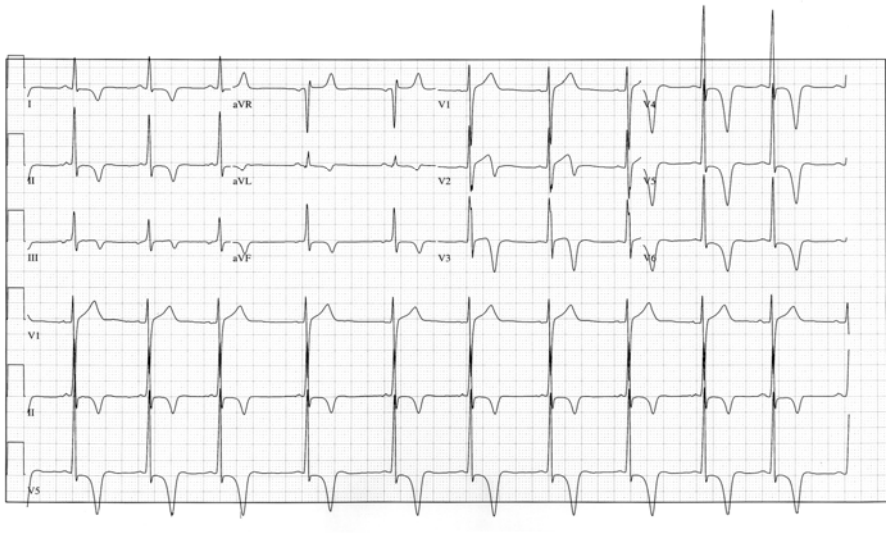
* passive surveillance, ascertainment and referral bias.



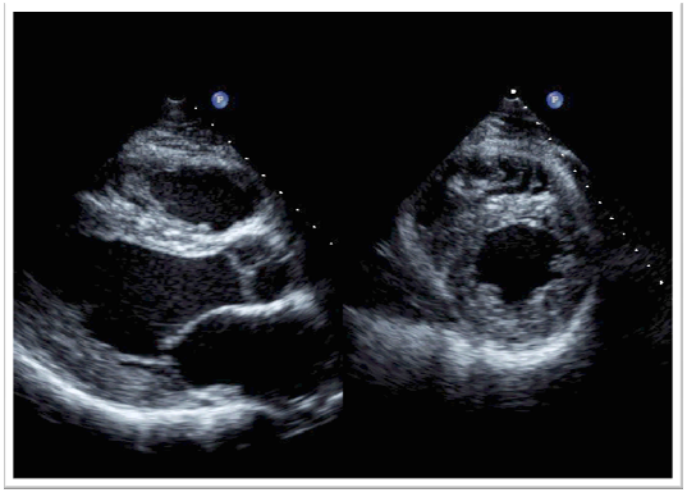
A 22 year old athlete who plays professional basketball (NBA) was evaluated for a second opinion regarding his abnormal ECG.

- In the pre-season had an abnormal EKG
- The team physician does not allow him to continue training
- The player's manager sends him for a second opinion

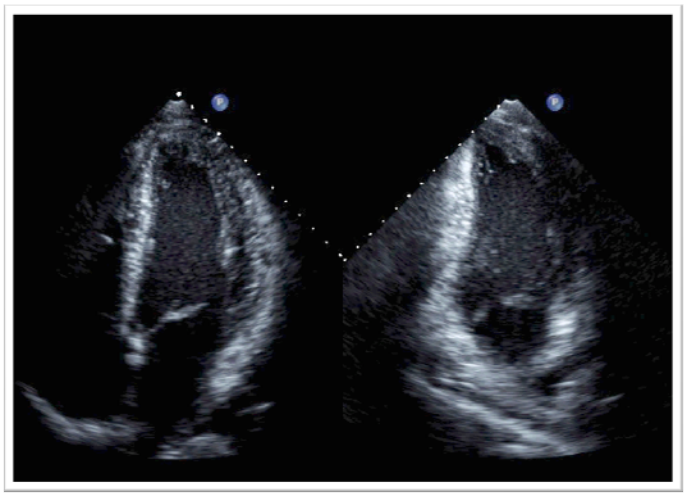
ECG



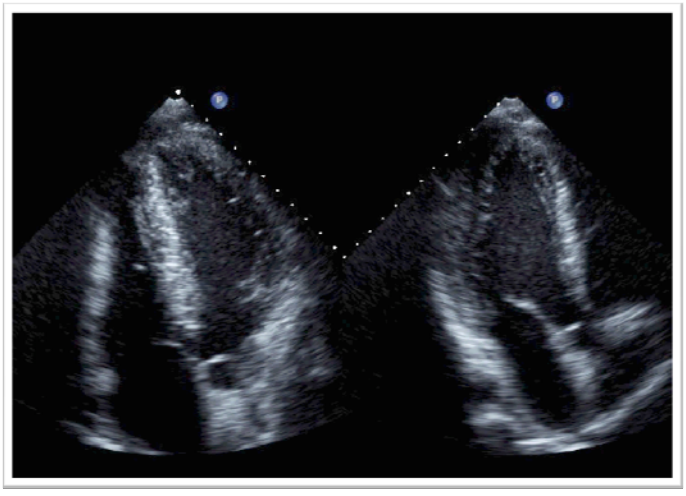
TTE: Basketball Player



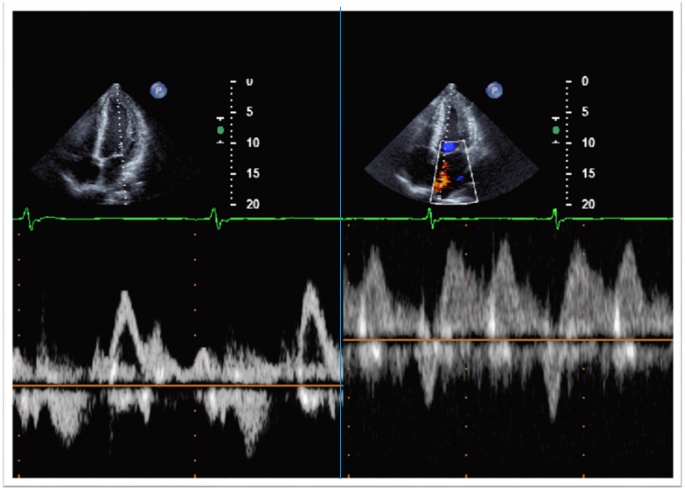
TTE



TTE

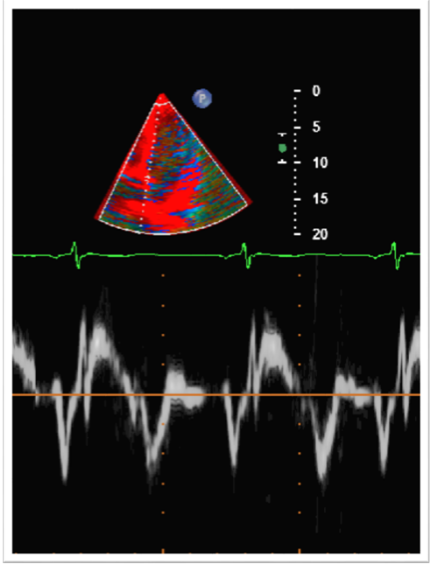


TTE



Mitral Inflow PV Flow

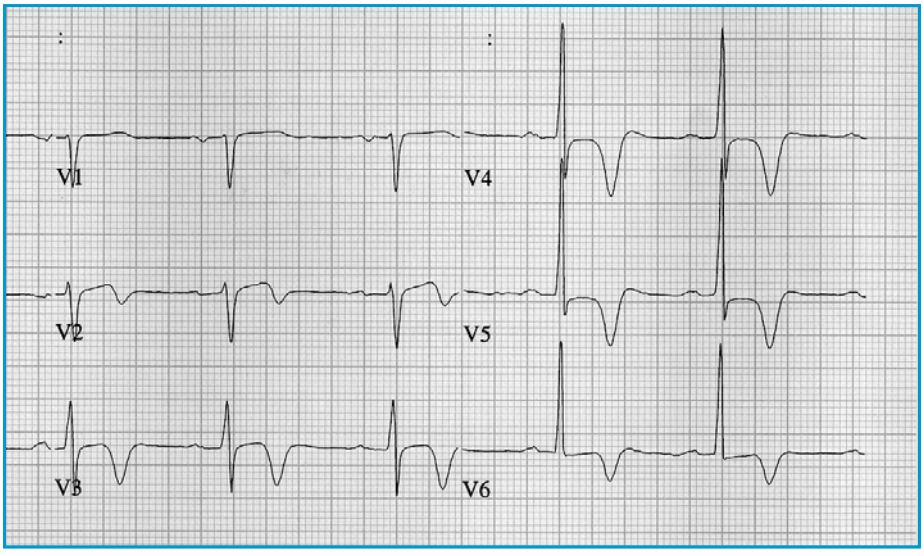
TTE: Tissue Doppler



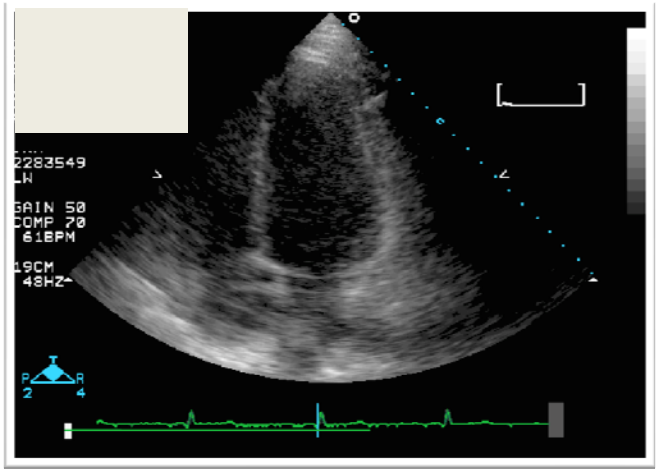
Findings: ECHO

- LV EDD = 5.2 cm
- LV ESD = 3.3
- WT = 1.33 cm
- LVEF = 68%
- Diastolic Function = normal
- Trivial MR

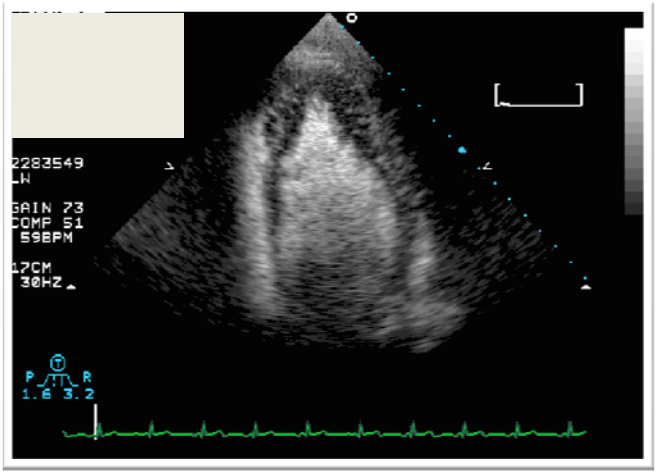
19 year old male, evaluated for an abnormal ECG



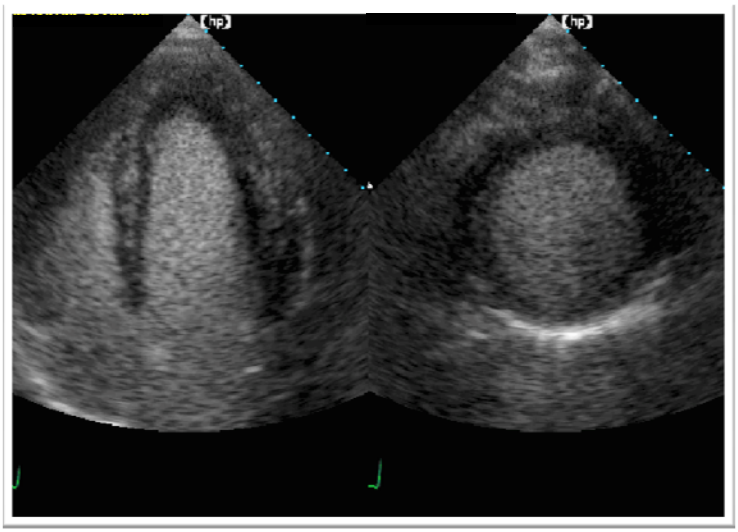
19 year old male, evaluated for an abnormal ECG



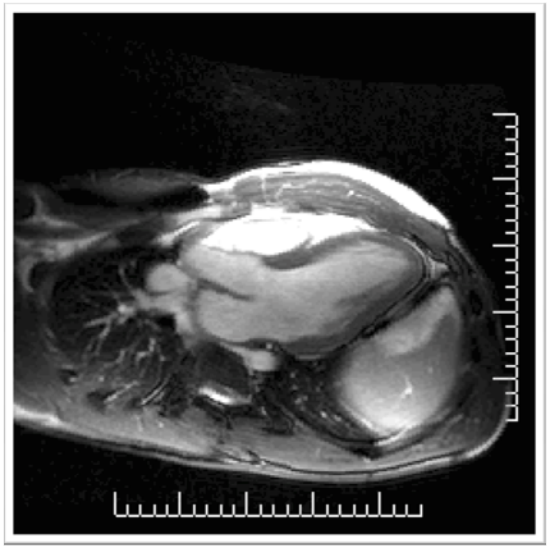
Apical CMP



ECHO (our athlete)

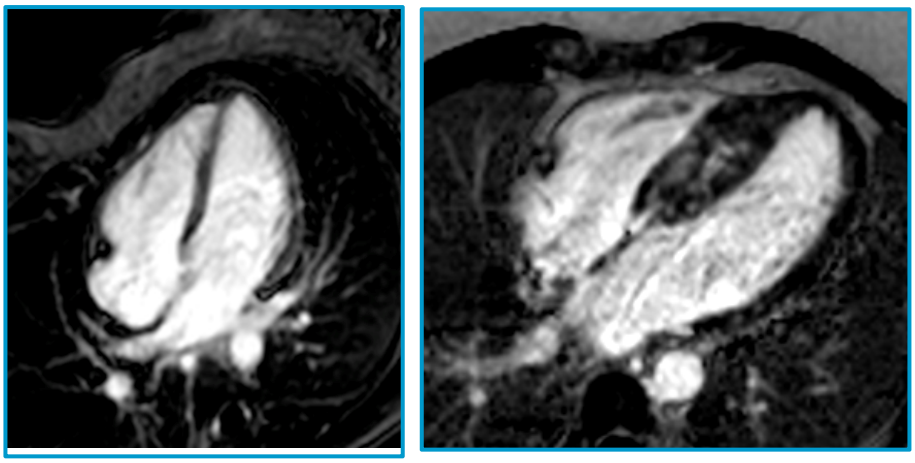


Cardiac MRI



Delayed Enhancement

LGE Typically Absent



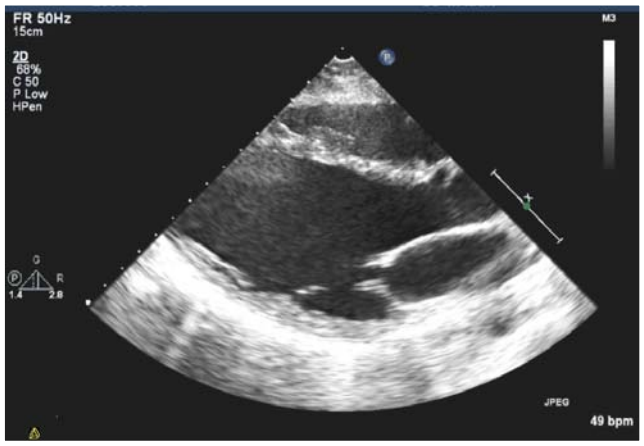
Fact:

- On the basis of this MRI, the patient was diagnosed as having localized HOCM and advised not play in the NBA.

A 24 year old athlete who plays a professional sport received his annual echocardiogram.

- In the pre-season his physician heard an abnormal murmur
- The team manager does not know whether the team should sign his multi-million contract

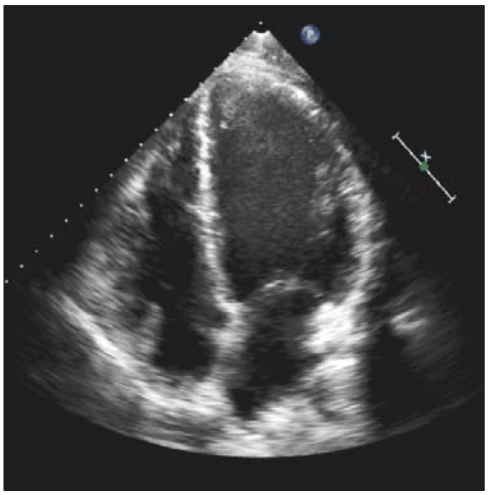
TTE: PLX

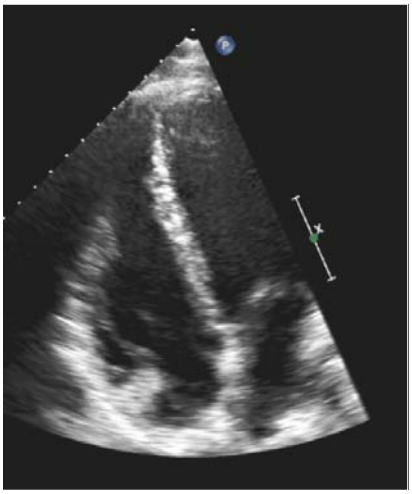


LVIDD 6.06 cm
LVIDS 4.06
PWT 1.18 cm

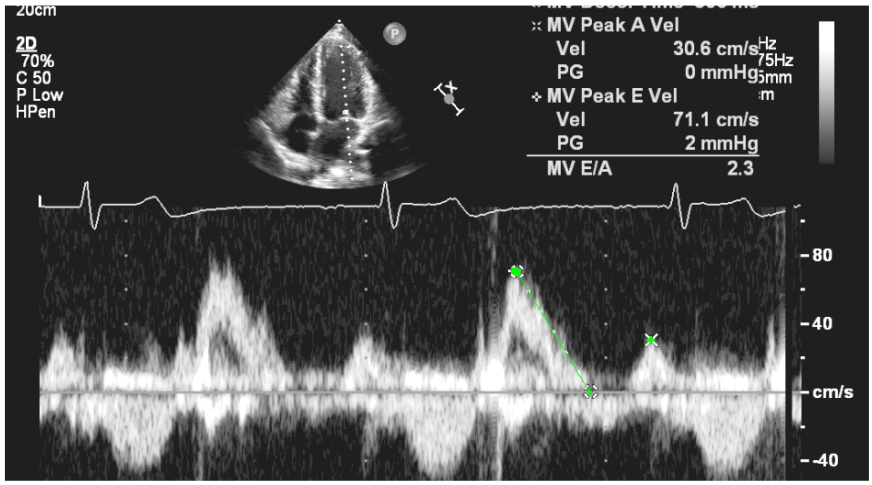
TTE: A4C

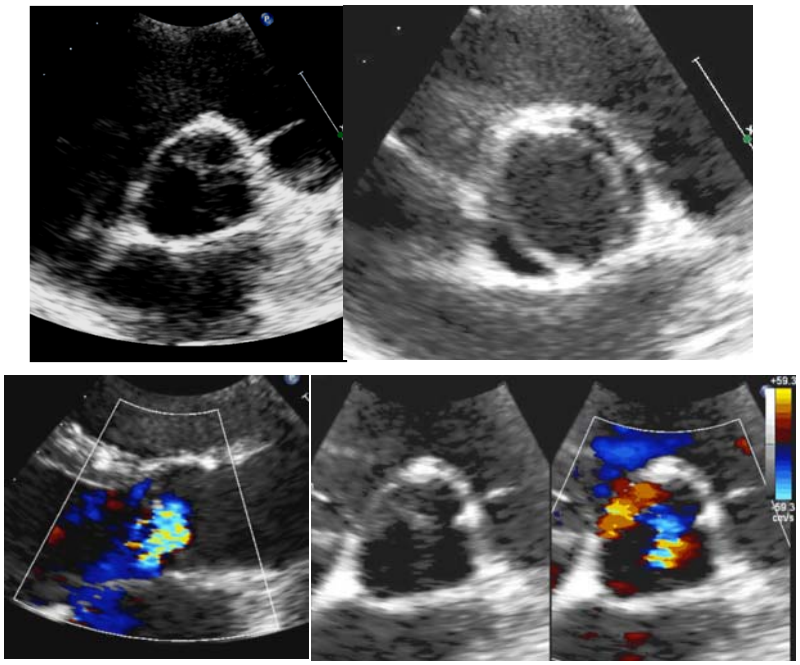
LVEF = 61%
LViD = 4.9cm

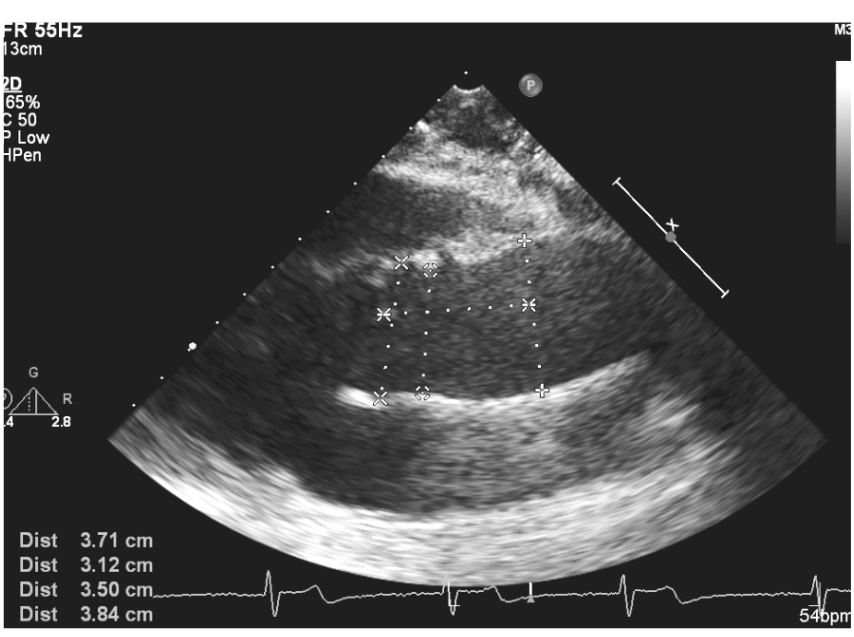




Doppler LV inflow






Dist 3.71 cm
Dist 3.12 cm
Dist 3.50 cm
Dist 3.84 cm
54bpm

Guidelines: Chronic severe AR

- **Asymptomatic patients and LV systolic dysfunction (LVEF<50%)**
- **Reasonable with normal systolic function but with severe LV dilatation (LVESD >50mm)**
- **Operative intervention to repair the aortic sinuses or replace the ascending aorta is indicated in patients with a bicuspid aortic valve if the diameter of the aortic sinuses or ascending aorta is greater than 5.5 cm**

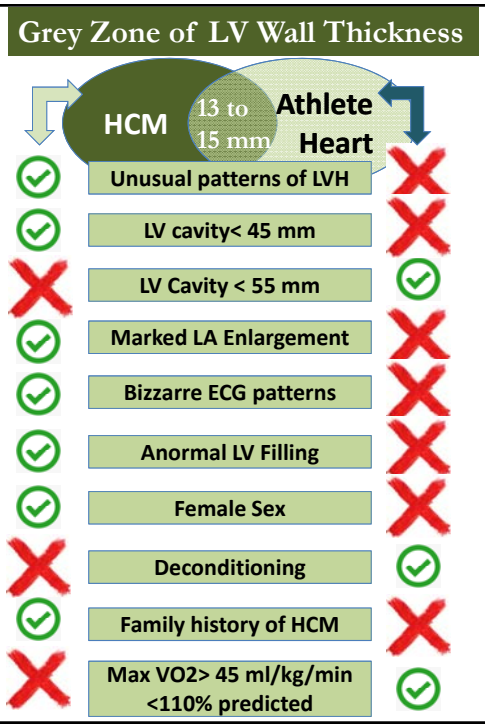
Athletes with VHD

- Moderate VHD are compatible with participation in most sports, with the exception of those with high static and high dynamic components.
- Athletes with severe VHD should be disqualified from participating in competitive sports until they have undergone the appropriate therapeutic procedure.
- Following valve repair or replacement, athletes can return to sports, although they should avoid high static and high dynamic sports.

Athletes Heart

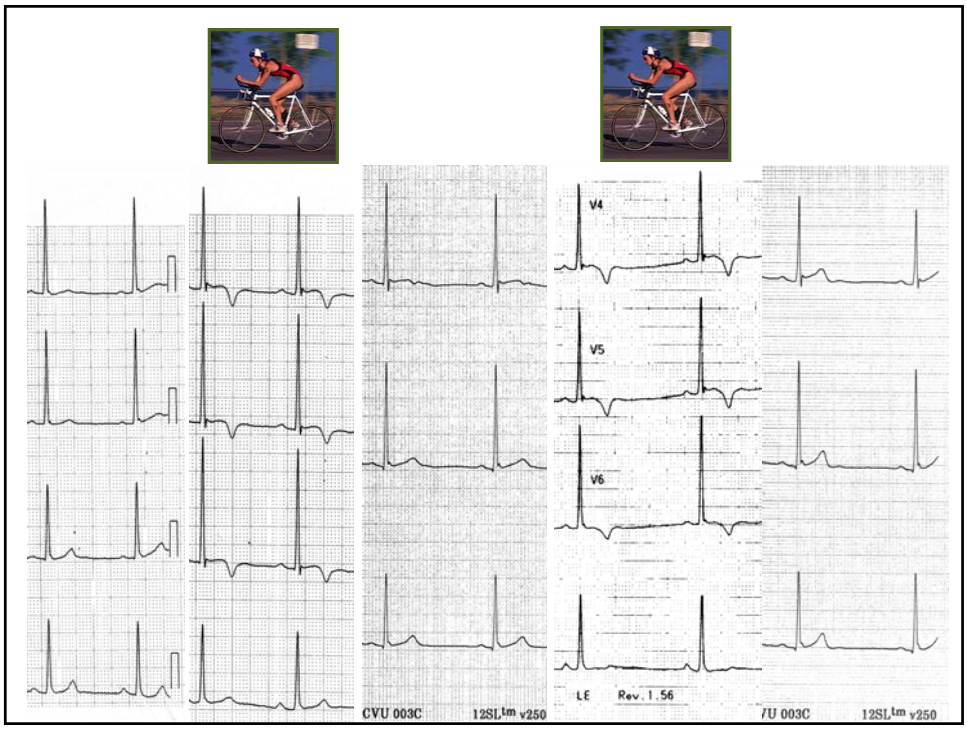
Pathological vs. Physiological Adaptation

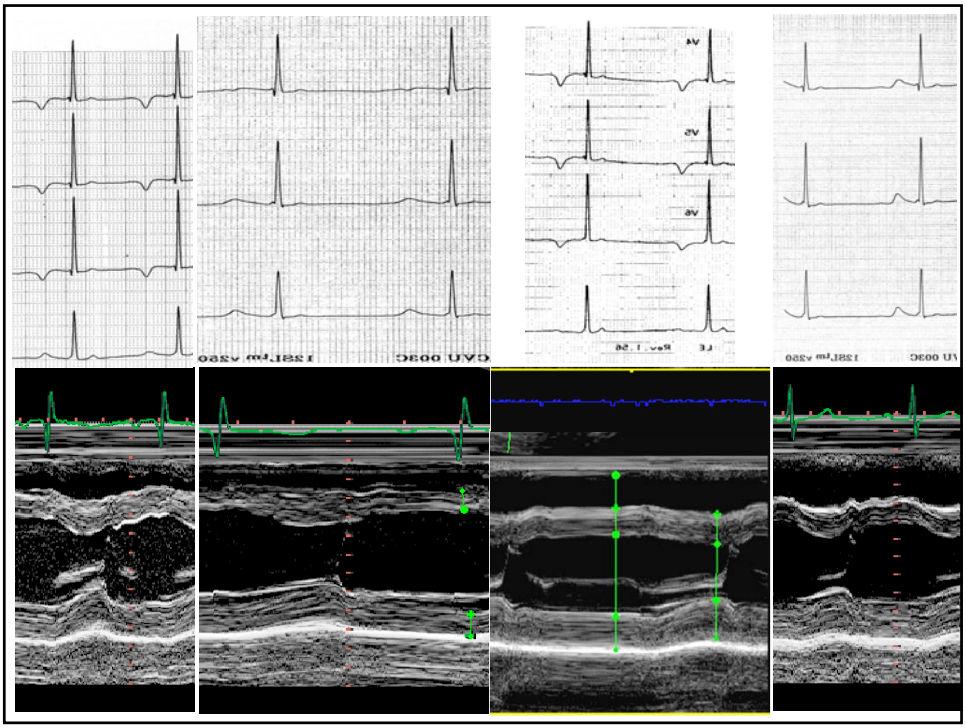
•The distinction between physiological remodeling of the athletes heart from pathological LVH in HCM is challenging with important implications for pre-participation screening



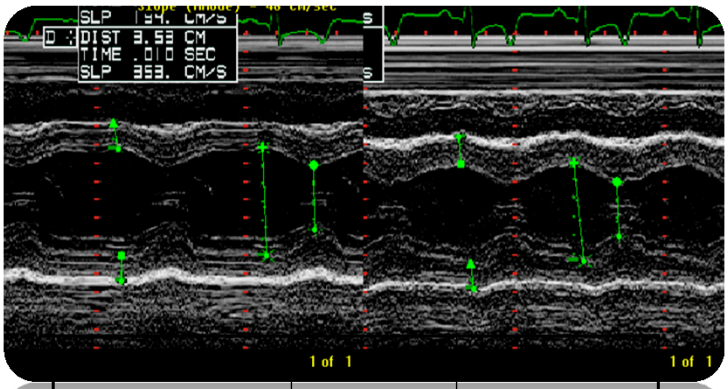
Detraining

- Complete cessation of training with intermittent imaging (6 weeks to 6 months)
- Discontinuing training affects wall thickening; cavity dilatation is not really modified
- Reversibility of LVH after detraining is in favor of athletes heart

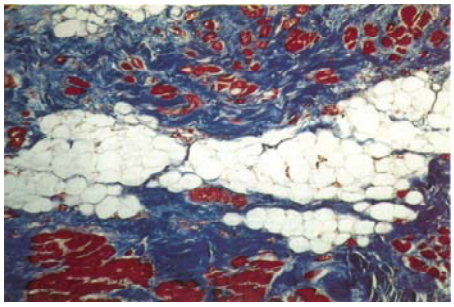


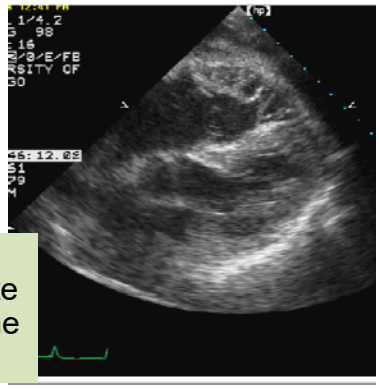


Echo Change caused by deconditioning



LVIDd(cm)	5.2	5.2
WT(cm)	1.32	1.10

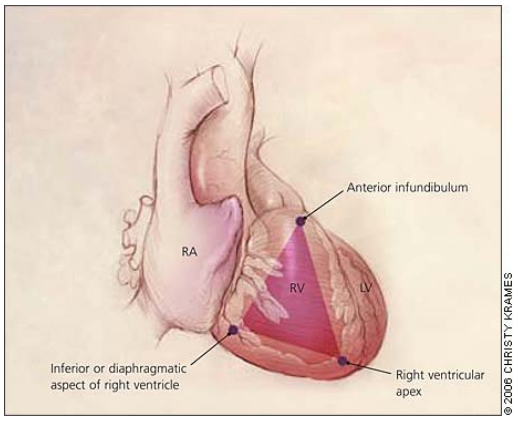




Arrhythmogenic Cardiomyopathy/ Dysplasia

Familial disease with autosomal dominant transmission and incomplete penetrance (important screening of the family).

The triangle of dysplasia

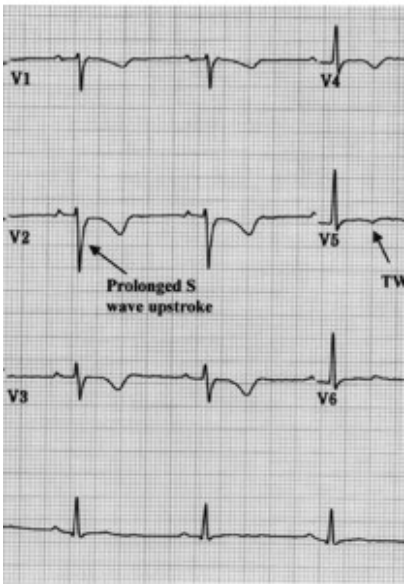


– Initially localized to the "triangle of dysplasia" then spread to the entire right ventricle, and in some cases to the left ventricle

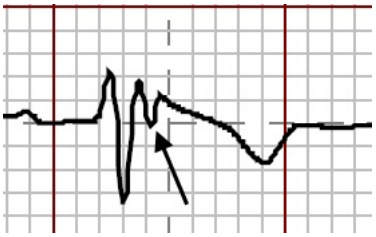
Clinical Presentation: ARVD

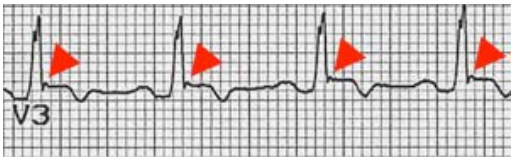
- Estimated prevalence 1 in 5000
- Patients usually young and health
- Males are affected three times more than females
- Symptoms vary from lightheadedness and palpitations to syncope and sudden death
- Symptoms may be exercise induced and can occur in athletes

ARVD: ECG

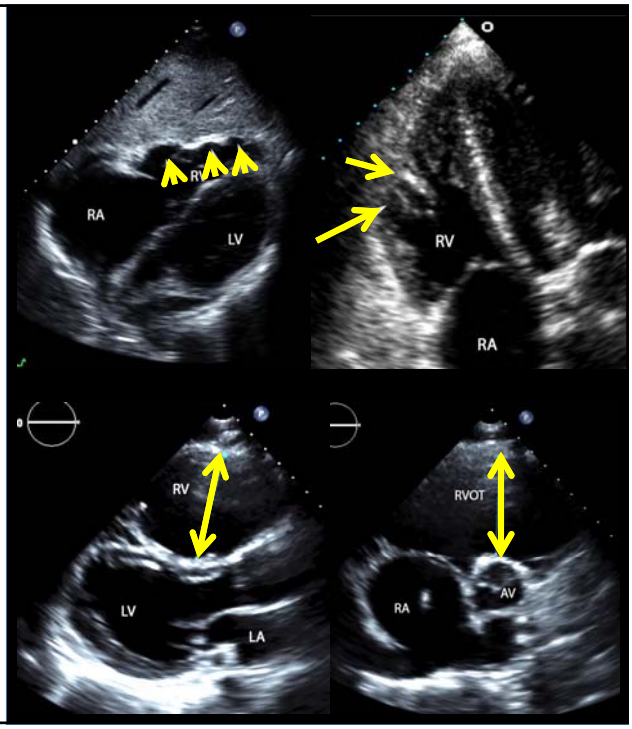


Terminal slurring QRS (epsilon wave)





Task Force (Revised Criteria)
MAJOR
Regional RV akinesia, dyskinesia and aneurysm and one of the following
PLAX ≥ 32 mm (≥ 19 mm/m²)
PSAX ≥ 36 mm (≥ 21 mm/m²)
FAC ≤ 33%
MINOR
Regional RV akinesia or dyskinesia and one of the following
PLAX 29-32 mm
PLAX 32-36 mm
FAC 33-40 mm



Conclusion

- A small LV cavity with increased WT should raise the suspicion of HOCM
- Disproportionate enlargment of the RV should raise the suspicion of ARVD
- Excesive dilatation of all cardiac chambers with low LVEF and failure to augment normally with exercise should raise the suspicion of DCM
- Reversal of remodeling through detraining may help to determine whether an observed structural abnormality is due to the athletes heart.

Thanks for your attention