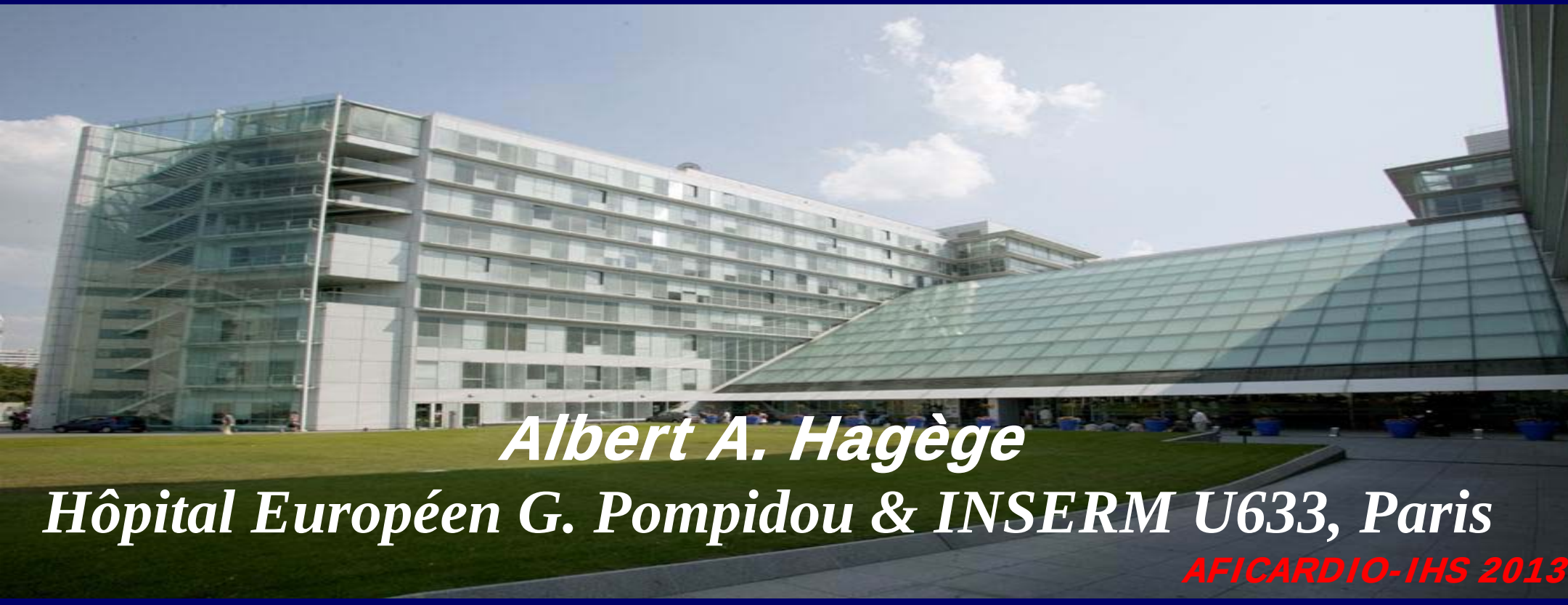
Echocardiographic assessment in hypertrophic cardiomyopathy

The Spectrum of Diagnosis and Management in HCM



Albert A. Hagège

Hôpital Européen G. Pompidou & INSERM U633, Paris

AFICARDIO-IHS 2013

Echo in HCM

Diagnosis

Prognosis

Therapeutics

Familial screening

ECHO DIAGNOSIS IN HCM

Unexplained LVH

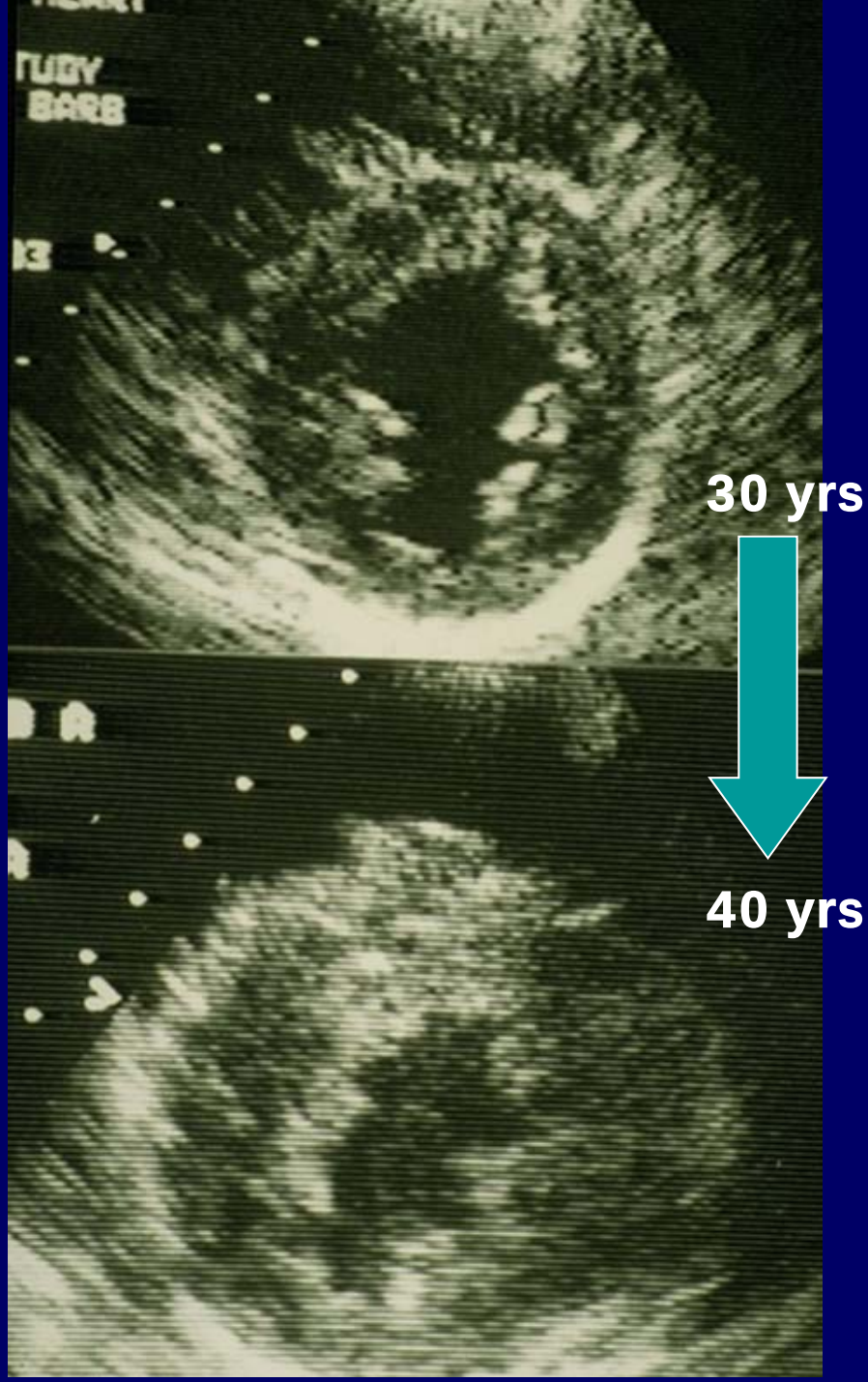
≥15 mm (13 if familial)

No LVH

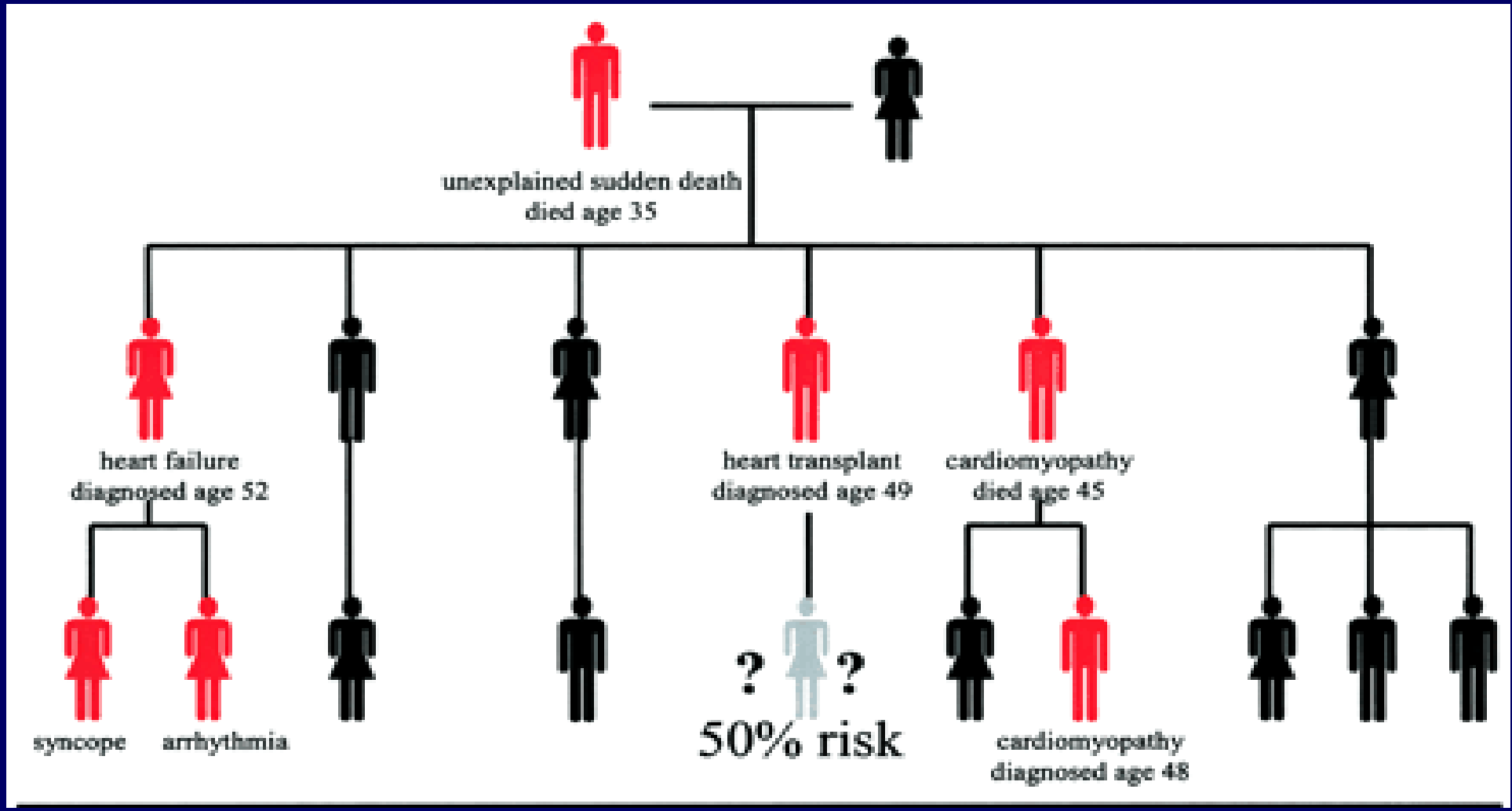
- **Child & adolescent**
- **Adult**

MyBPc mutations (France - 30%)

Maron JACC 2001

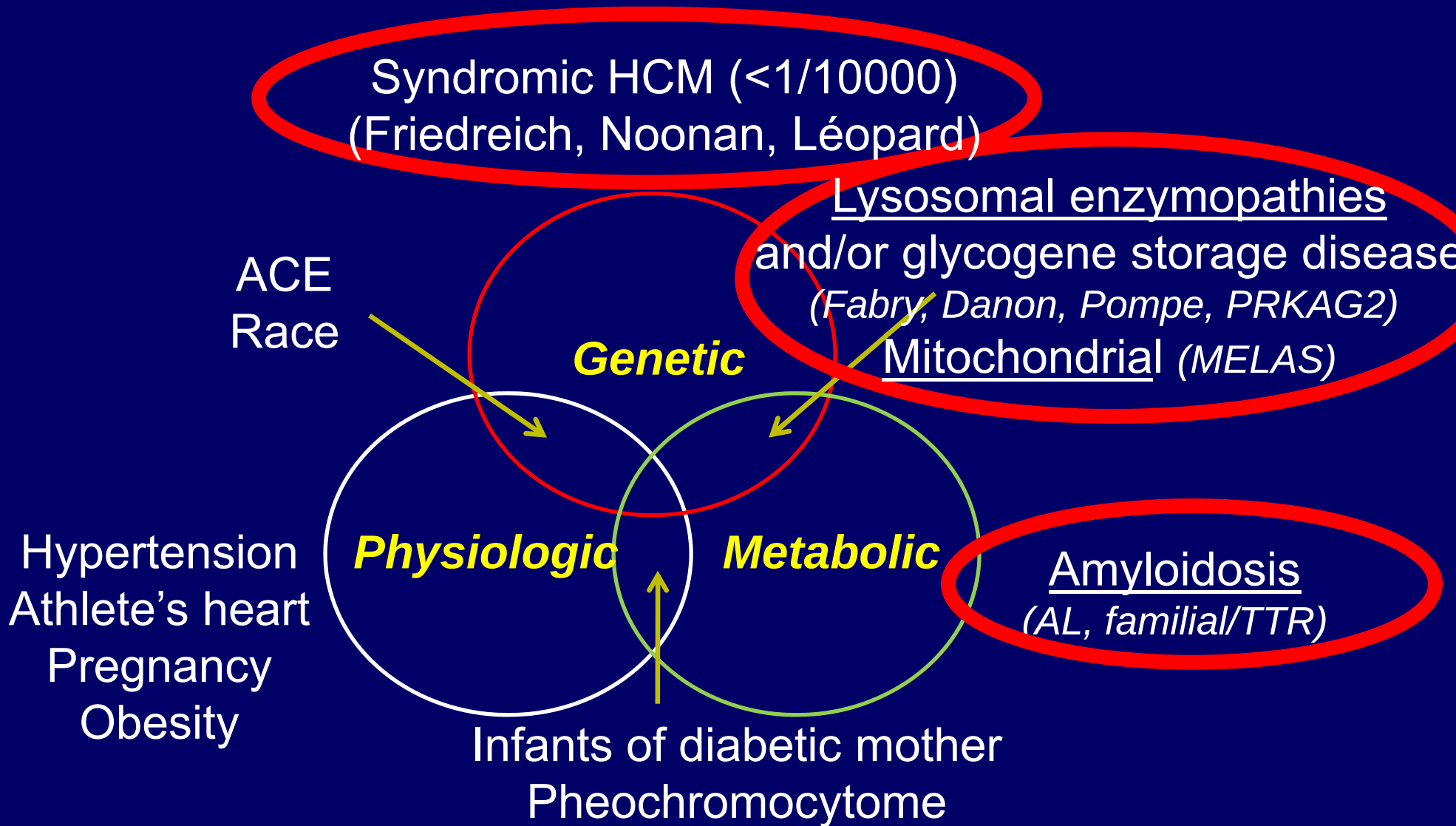


Usual cause of HCM
Sarcomeric gene defect
Autosomal dominant transmission



CAUSES OF HCM

Sarcomeric HCM (1/500)



Echo in HCM

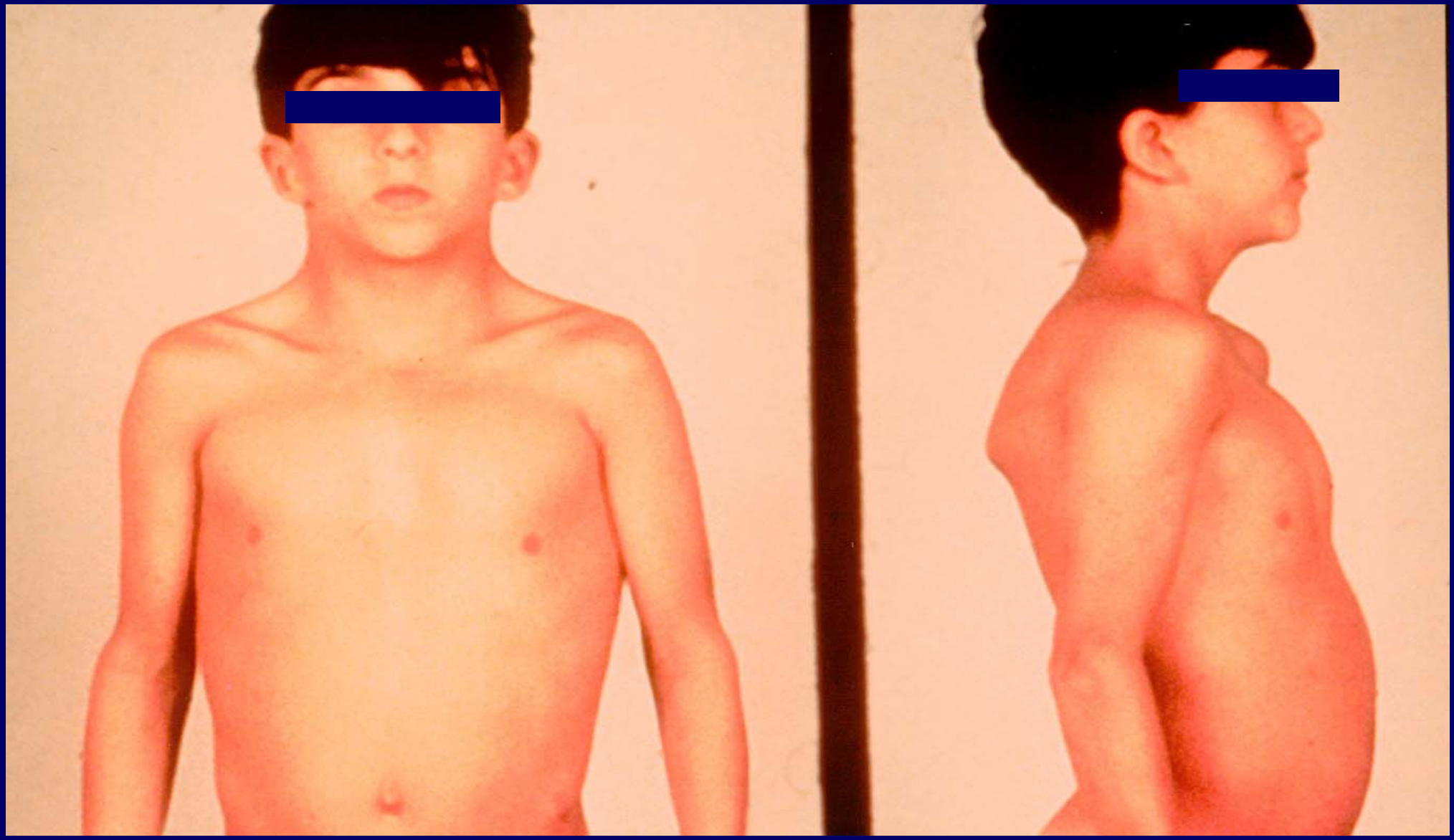
Diagnosis (Differential)

Prognosis

Therapeutics

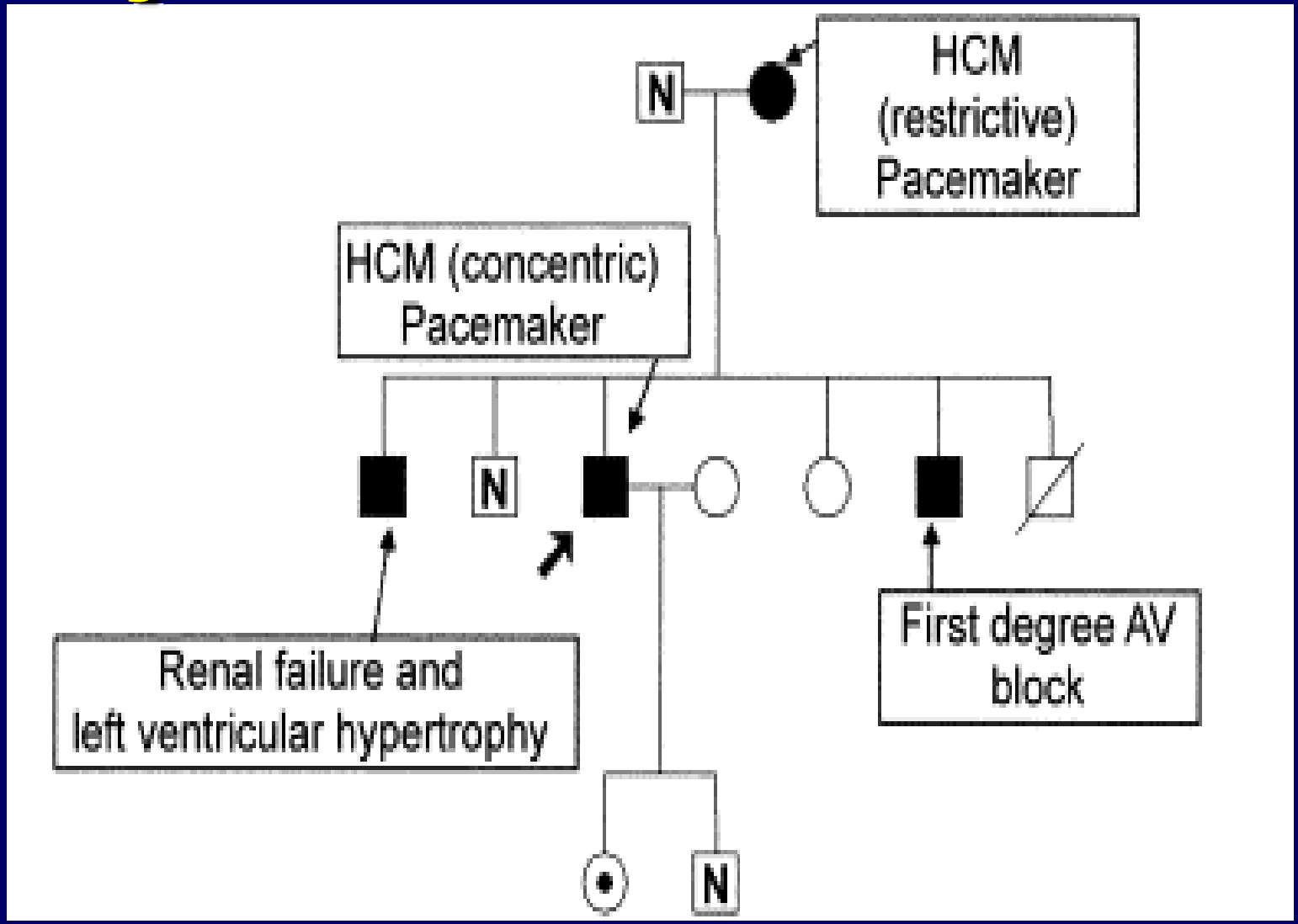
Familial screening

Syndromic HCM (Noonan)



Non-cardiac signs
Fabry disease

Non-autosomal transmission
Fabry : X-linked transmission



Monserrat, JACC 2007

The problem

Sporadic patient with « isolated » LVH :

Sarcomeric HCM or not ?

Genetics

1 – Genetic profile is currently only scarcely performed and always patient-orientated

2 – When performed, a negative test (> 40%) is not conclusive for the absence of a sarcomeric disease

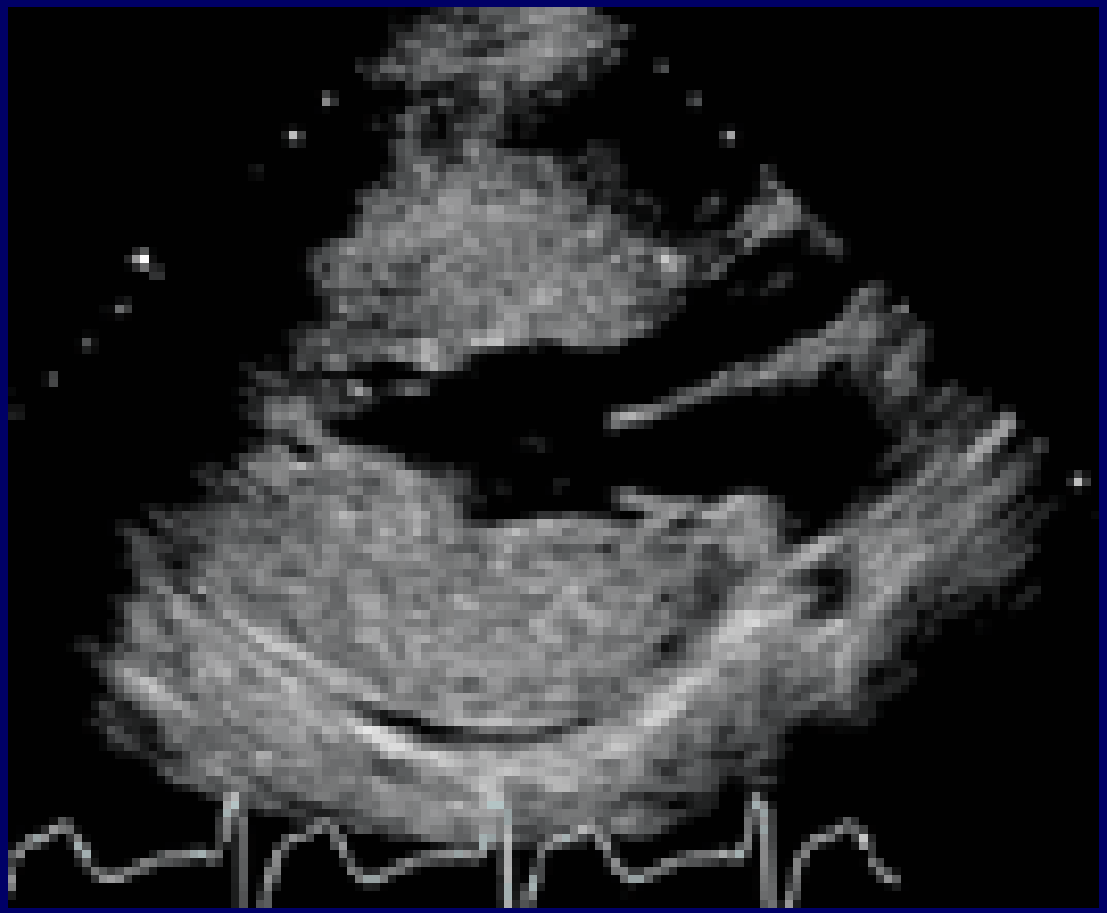
RED FLAGS : ECHO

- Concentric LVH: amyloidosis, mitochondrial disease, Fabry, if ≥ 30 mm Danon
- Global LV hypokinesia +/- dilatation : Fabry, mithochondrial, TTR amyloidosis, PRKAG2, Danon, end-stage sarcomeric
- Pericardial effusion, increased interatrial septal thickness, ground-glass septum appearance: Amyloidosis
- Increased thickness of the RV free wall or AV valves: Amyloidosis or Fabry

ESC guidelines, Eur Heart J 2013

Amyloidosis Mitochondrial

Fabry disease



Binary appearance of the myocardium (Fabry disease)

Pieroni, JACC 2006;47:1663-71

FABRY Disease: Cardiac variant

FOCUS Study (French Society Cardiology)

- HCM Pts : 392 (supposed sarcomeric origin)
- Systematic dosage α-gal A
- < 20% & genetic confirmation
- Fabry disease
  - 4 male pts **(1.8% of male ≥ 40 yrs)**
  - 3 PM, Asymetric LVH, 2 obstructive (1 TASH)
  - Identification of 8 pts Fabry in families

Hagège, Heart 2011;97:131-6

TTR Amyloidosis: Cardiac variant

Italian registry

- Pts : ATTR (186), SSA (30), HCM (30)
- Phenotype exclusively cardiac (17%), exclusively neurologic (25%), mixed (58%)
- TTR cardiac variants
  - **Male > 65 yrs** (>90%)
  - **HF signs** (40% III/IV)
  - **Symetric LVH** (97%)
  - **Moderately depressed LVEF** (35-55%)
- ATTR (autosomal dominant) similar to senile systemic amyloidosis (SSA)

Rapezzi, Eur Heart J 2013;34:520-8

RED FLAGS : BIOLOGY

- Systematic
  - NFS (leucocytopenia in mitochondrial diseases)
  - CK, ALAT, ASAT (mitochondrial, Danon, glycogenosis)
  - Protein electrophoresis (AL amyloidosis)
  - Proteinuria, creatinin levels (Fabry, amyloidosis)
- Clinically-orientated
  - AL amyloidosis: urinary/plasma protein immunofixation, plasma free light chains
  - DNA testing : Sarcomeric, ATTR, Fabry
  - Fabry disease: α-gal A level (male)
  - Mitochondrial disease: lactic acidosis, myoglobinuria

Rapezzi, Eur Heart J 2013

RED FLAGS : OTHERS

- **Clinical signs**
  - Cutaneous : Fabry (angiokeratoma, hypohydrosis)
  - Neuropathy: Fabry, amyloidosis (bilateral carpal tunnel syndrome)
  - Stroke (w/wo symptoms): Fabry
- ECG
  - **Short PR** : Fabry, mitochondrial, Danon, PRKAG2
  - **A-V block**: Fabry (w/wo PM), amyloidosis, Danon
  - **Low QRS voltage** (or normal despite echo LVH): amyloidosis
- MRI LGE
  - Focal/patchy or at the septal junctions : Sarcomeric
  - **Diffuse subendocardial** : Amyloidosis

Rapezzi, Eur Heart J 2013

Echo in HCM

Diagnosis (athlete)

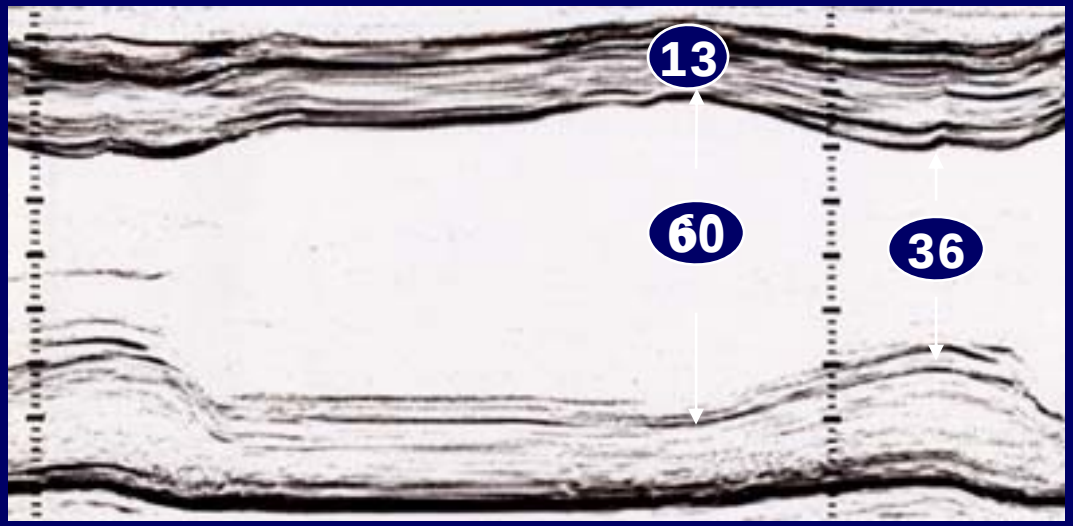
Prognosis

Therapeutics

Familial screening

ATHLETE'S HEART

Cycling, male, competition

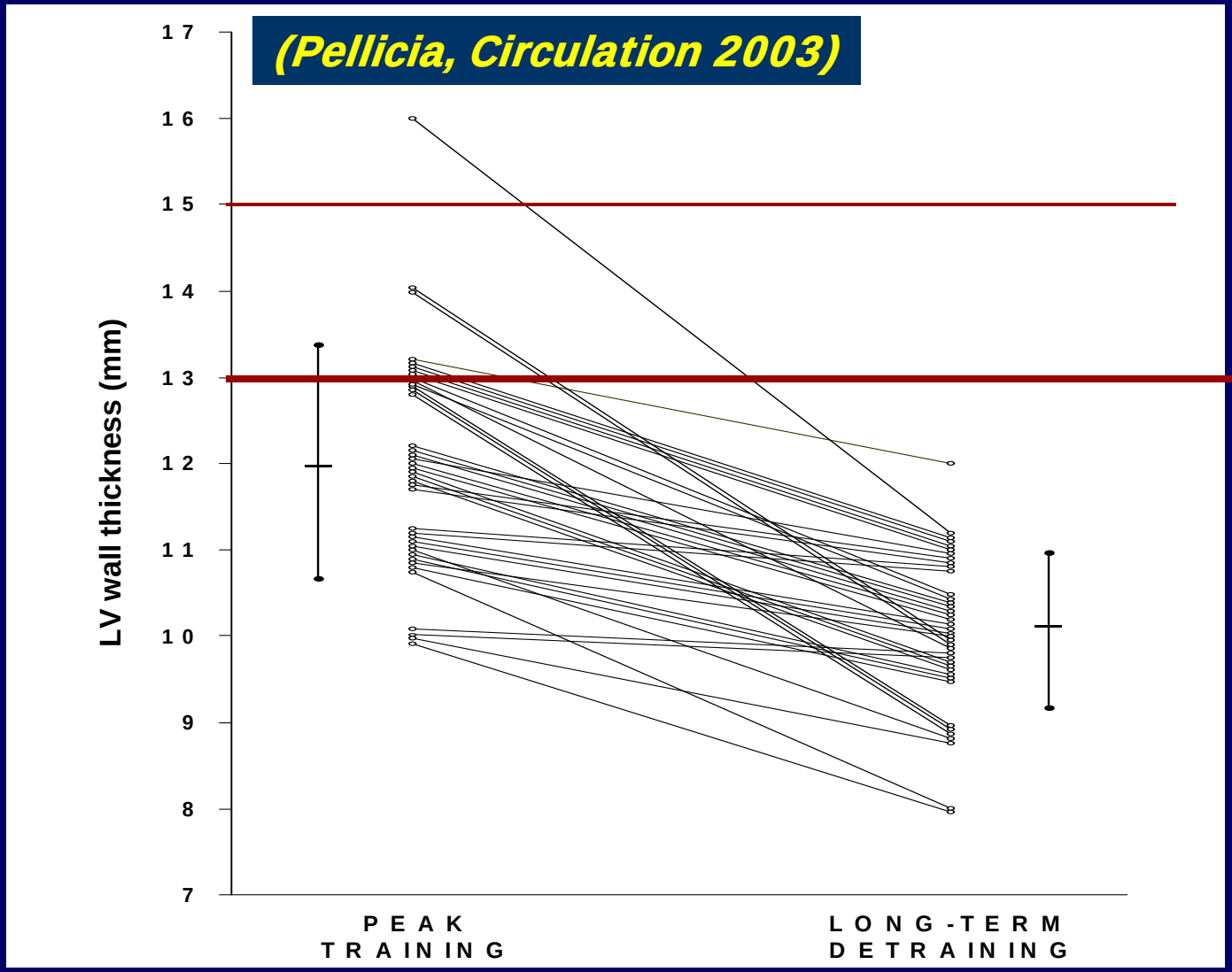


PHYSIOLOGIC LVH IN ATHLETES (>10h/w)

- Adolescents (14-18 yrs) *Sharma, JACC 2002*
  - ≤ 12 mm in male
  - ≤ 11 mm in female
  - 0.5% (all male) 13-14 mm, all with LV > 48 mm & E/A >1
- Adults *Pellicia, NEJM, 1991*
  - All female ≤ 11 mm
  - 2% (all male) with LVH ≥ 13 mm, but LV > 55 mm

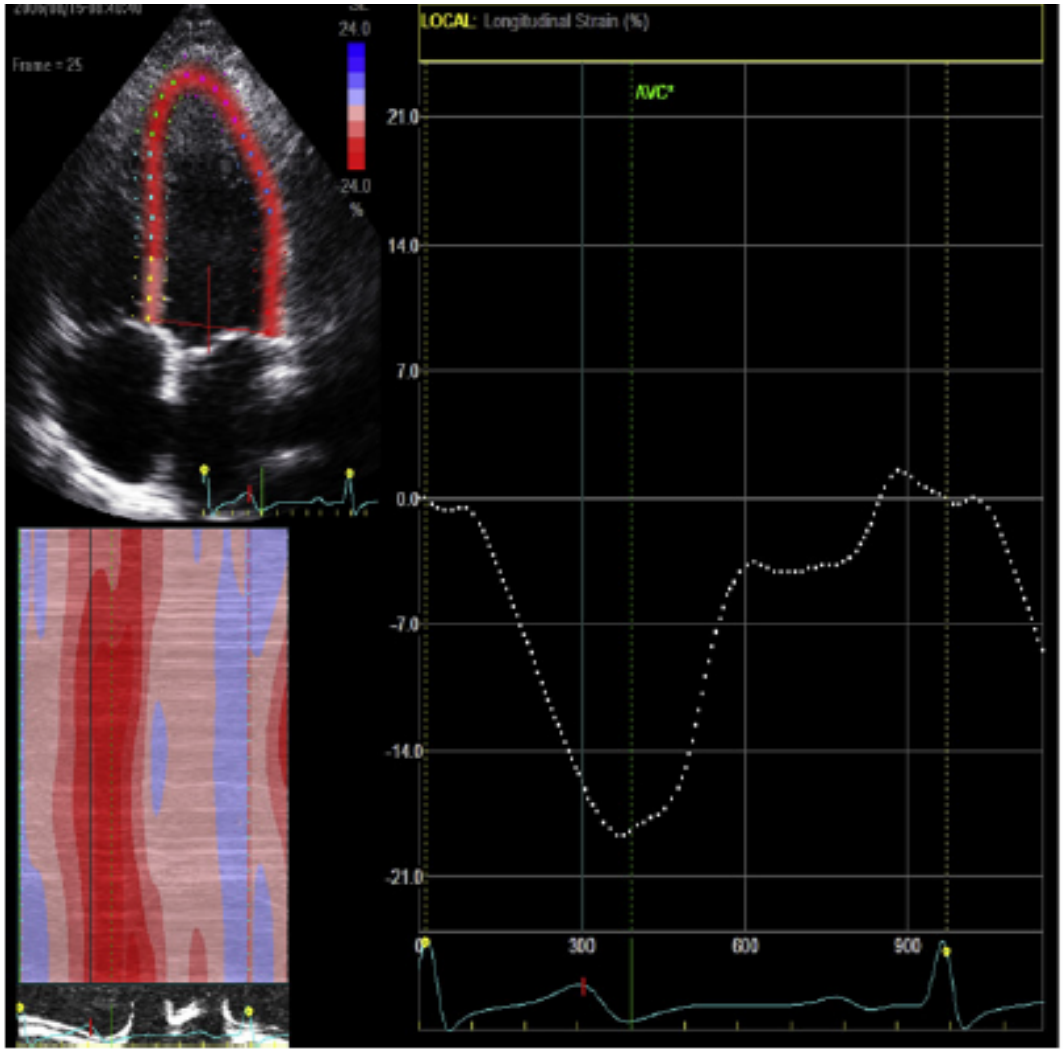
Alert : 12 mm in female & 13 mm in male

LVH & deconditioning (>8 w)

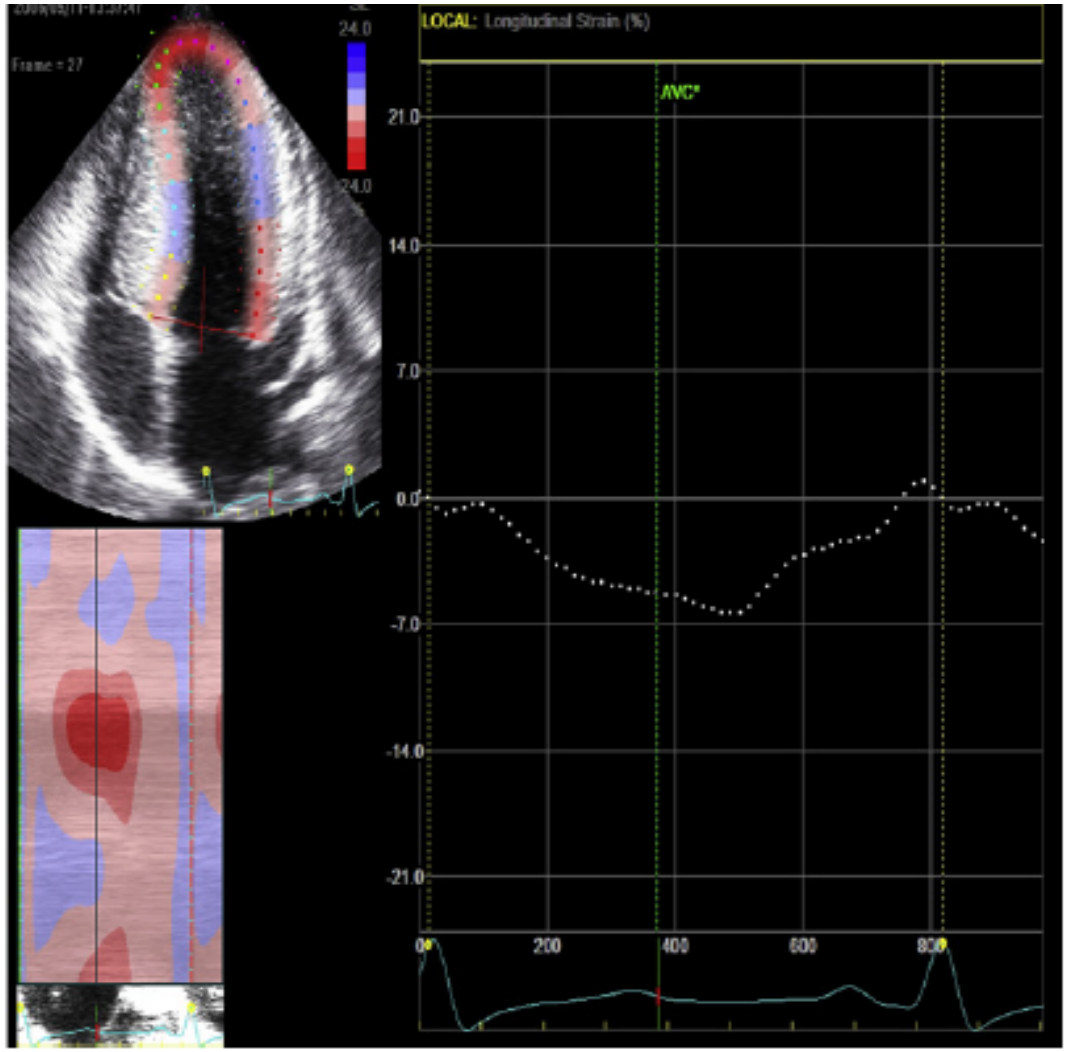


LV global longitudinal strain

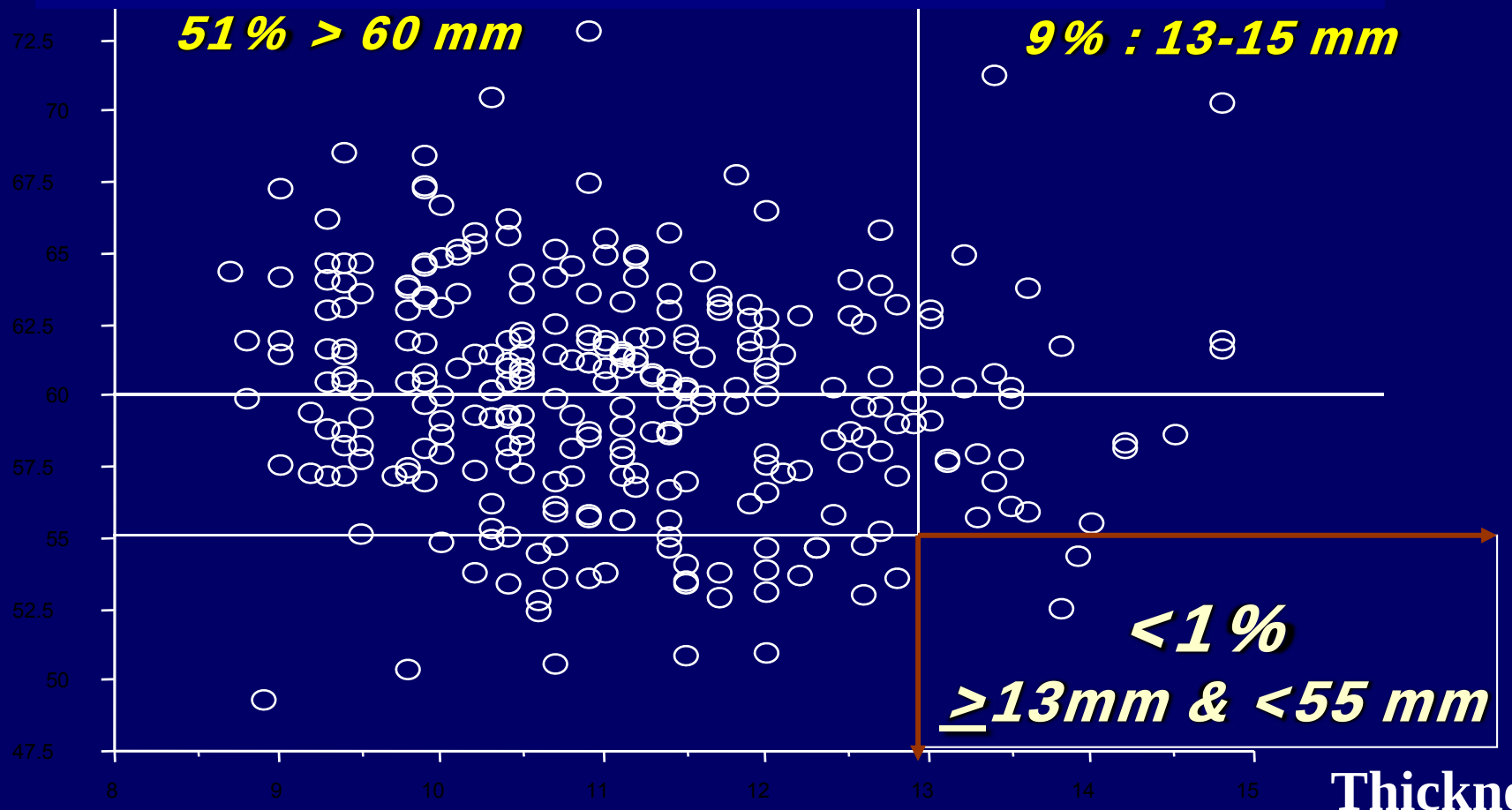
Normal, Athlete



CMH



Very high competitive athletes
"*Tour de France*"



N (athletes)	9	67	148	226	261	280	286

Abergel & Hagège , JACC 2005

Echo in HCM

Diagnosis

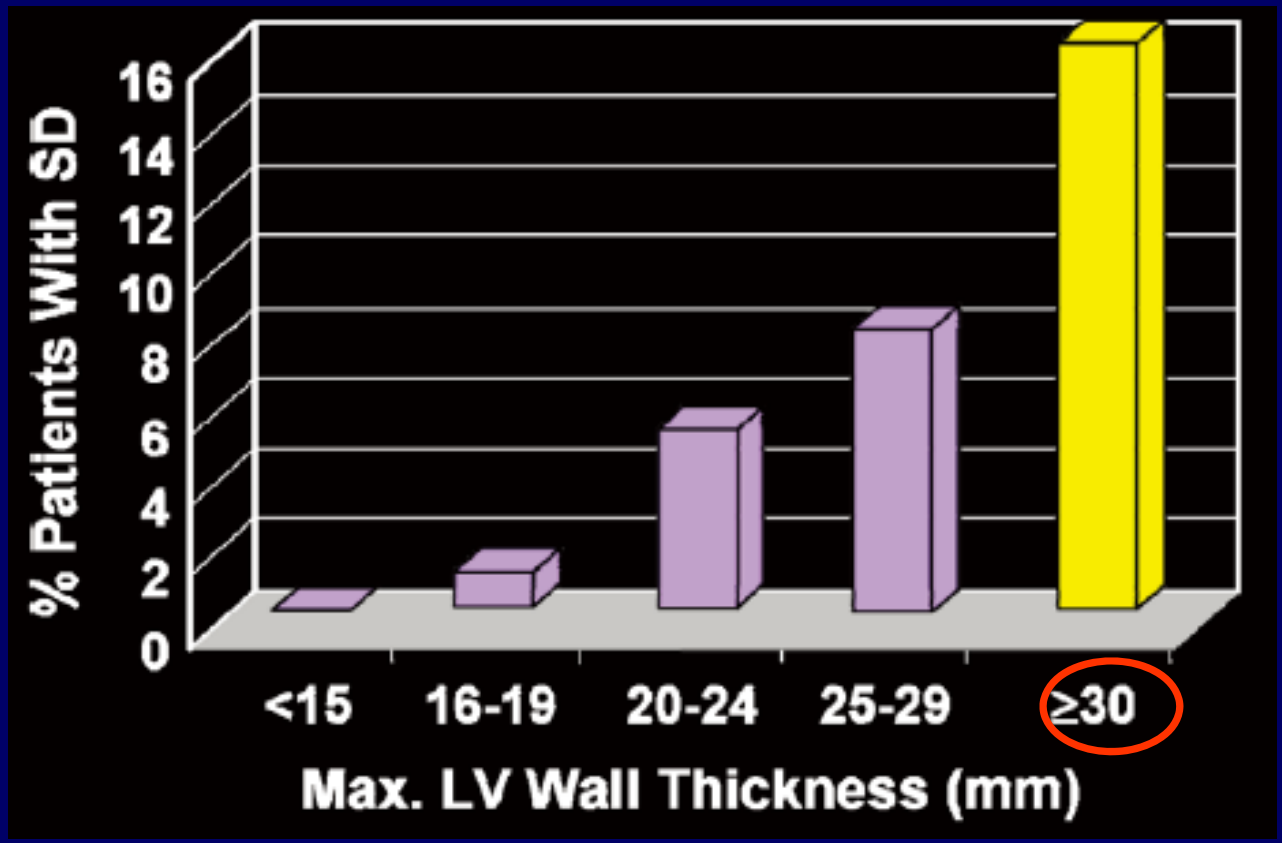
Prognosis

Therapeutics

Familial screening

Malignant LVH (≥ 30mm)

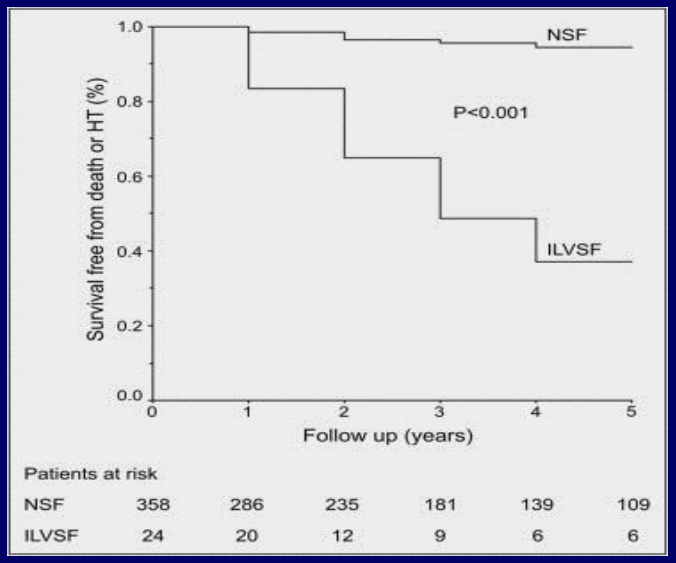
1/10 Pts but 1/4 SCD



A major risk factor for SCD

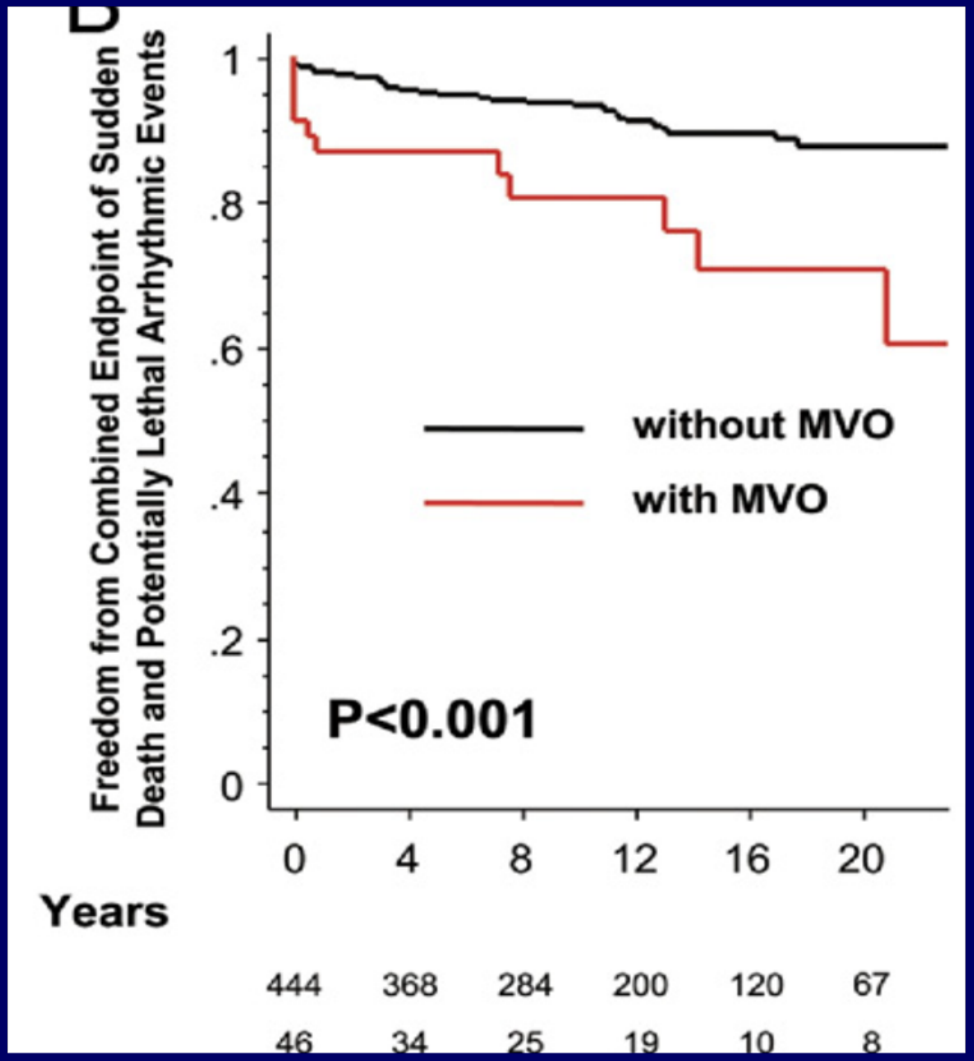
Spirito NEJM 2000

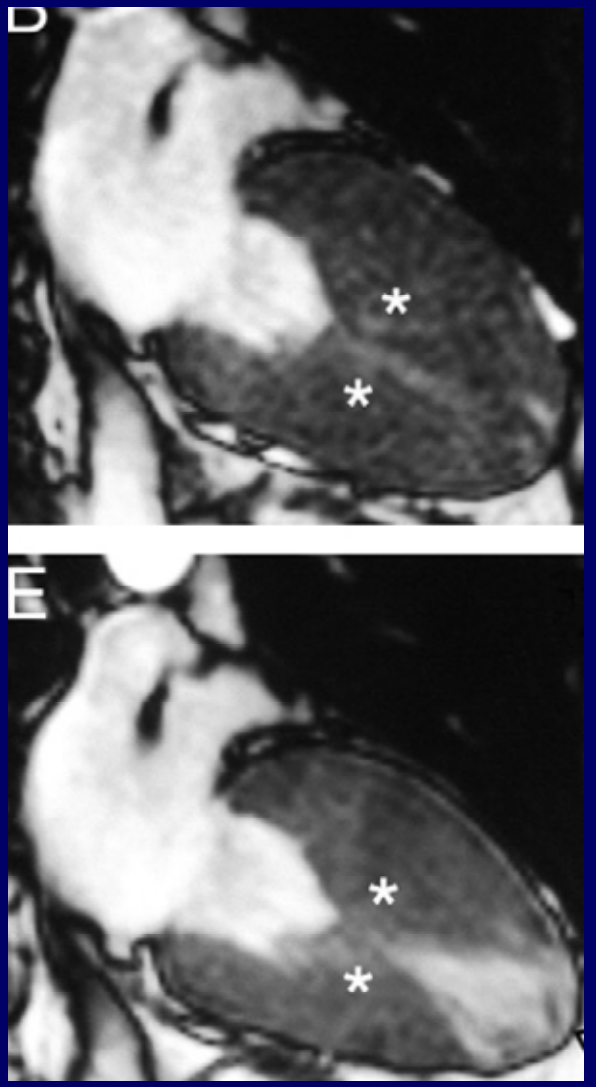
Restrictive pattern & “end-stage”



- **LVEF < 50 %**
- Short E deceleration time
- Atrial dilatation
- Wall thining

Mid-LV obstruction





T 0

4 yrs

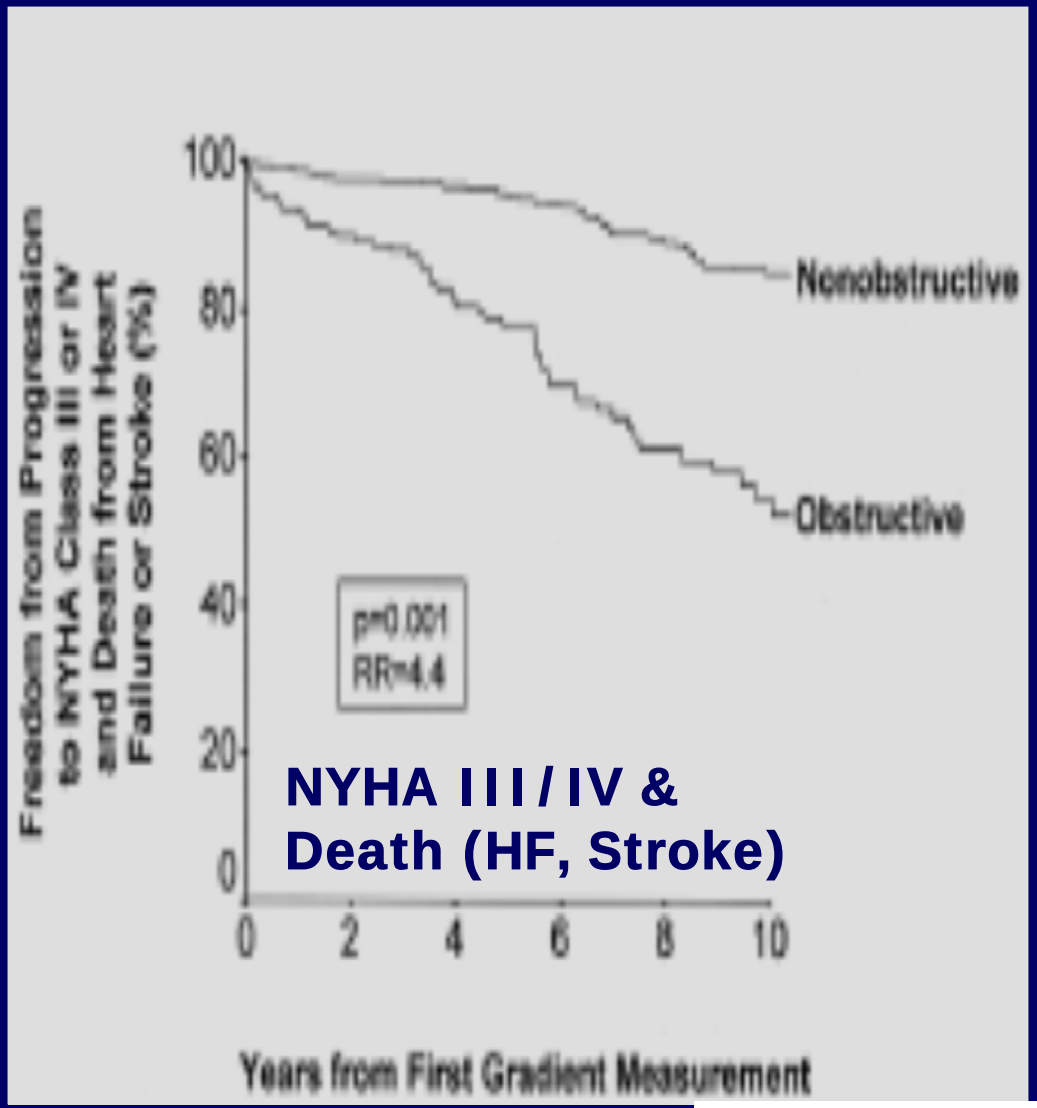
LV apical aneurysm

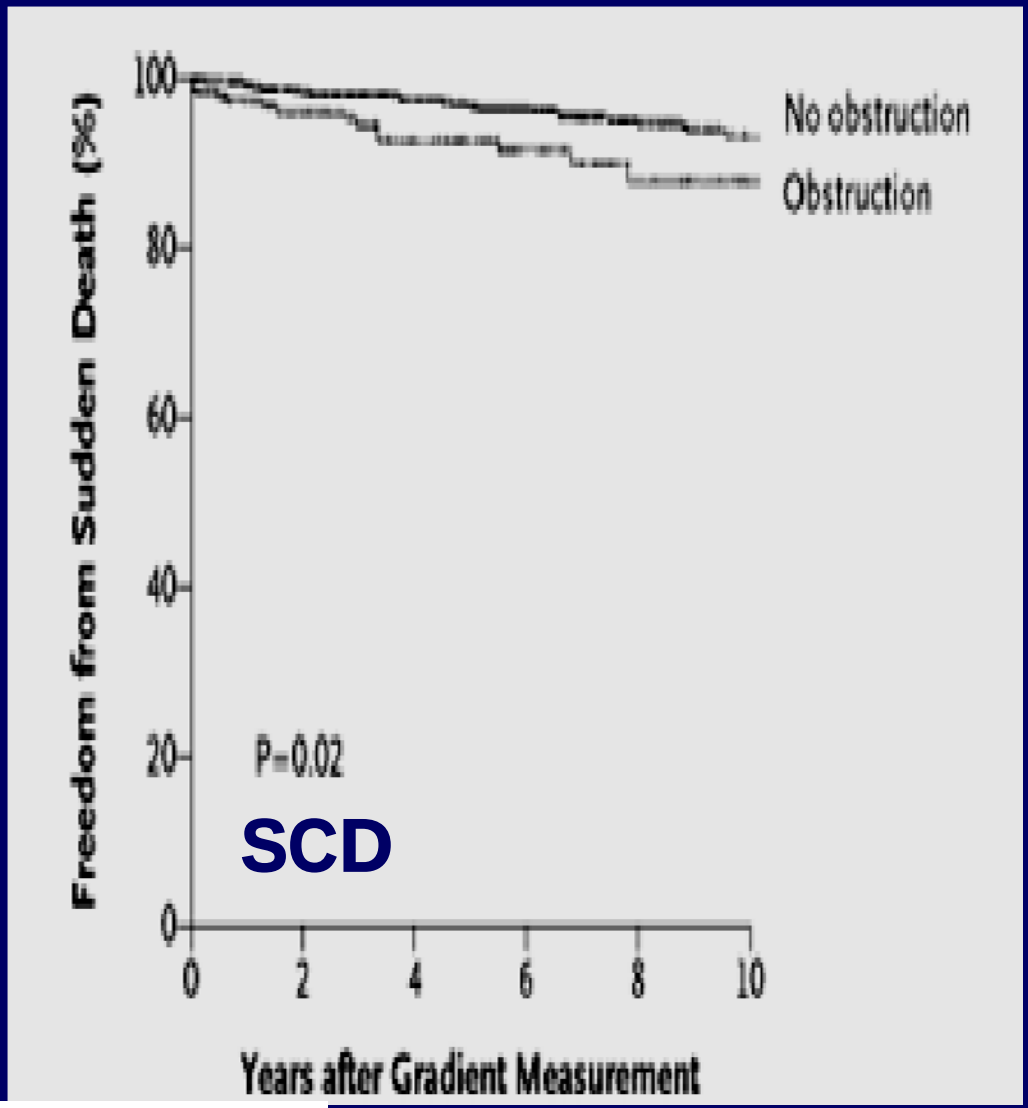
(2% pts, MCE 10%/yr)*

** SCD, CHF, Stroke*

Maron, Circulation 2008

Resting gradient ≥ 30 mmHg



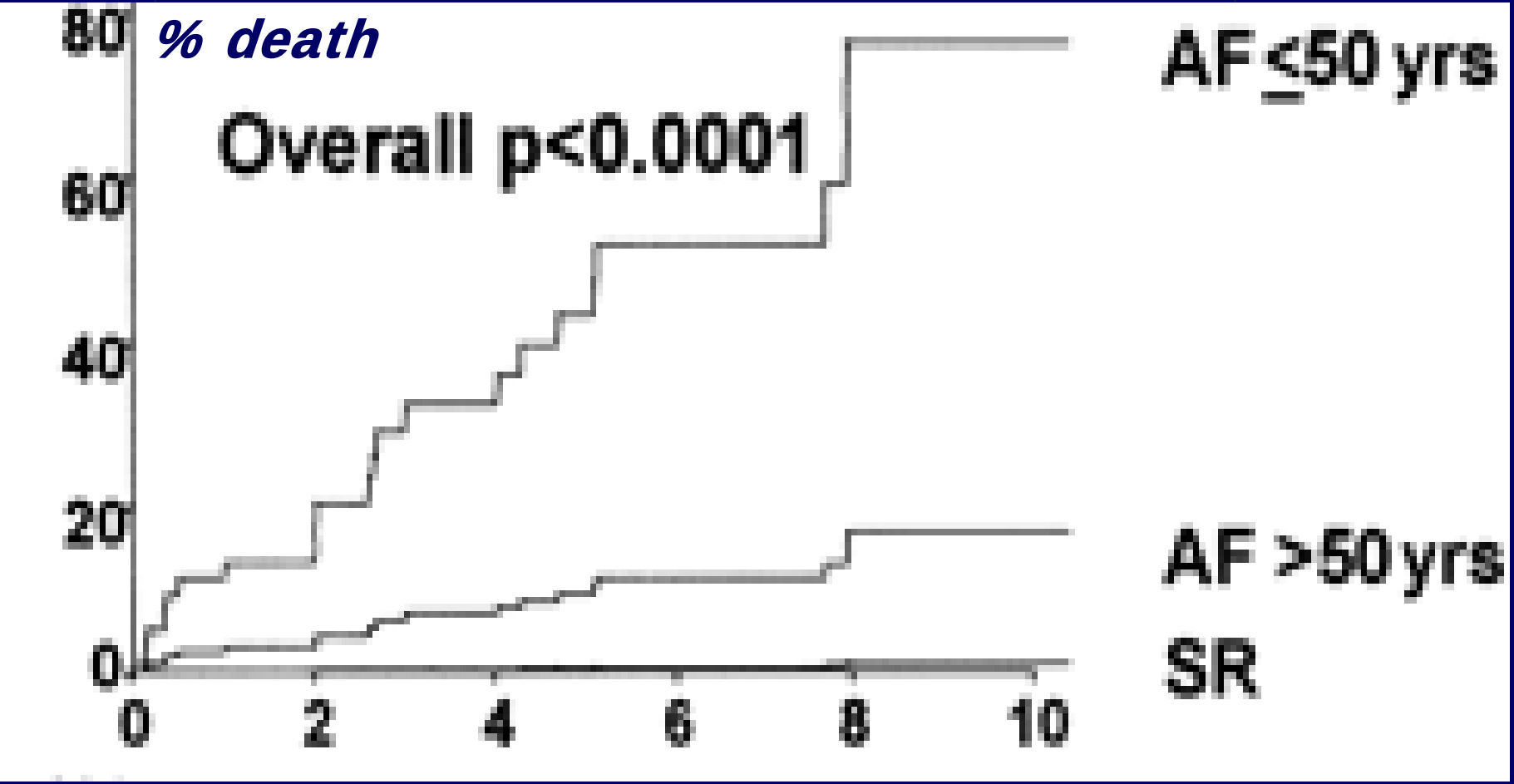


Yrs post-echo (1100 pts)

Maron NEJM 2003

LA size at diagnosis & AF

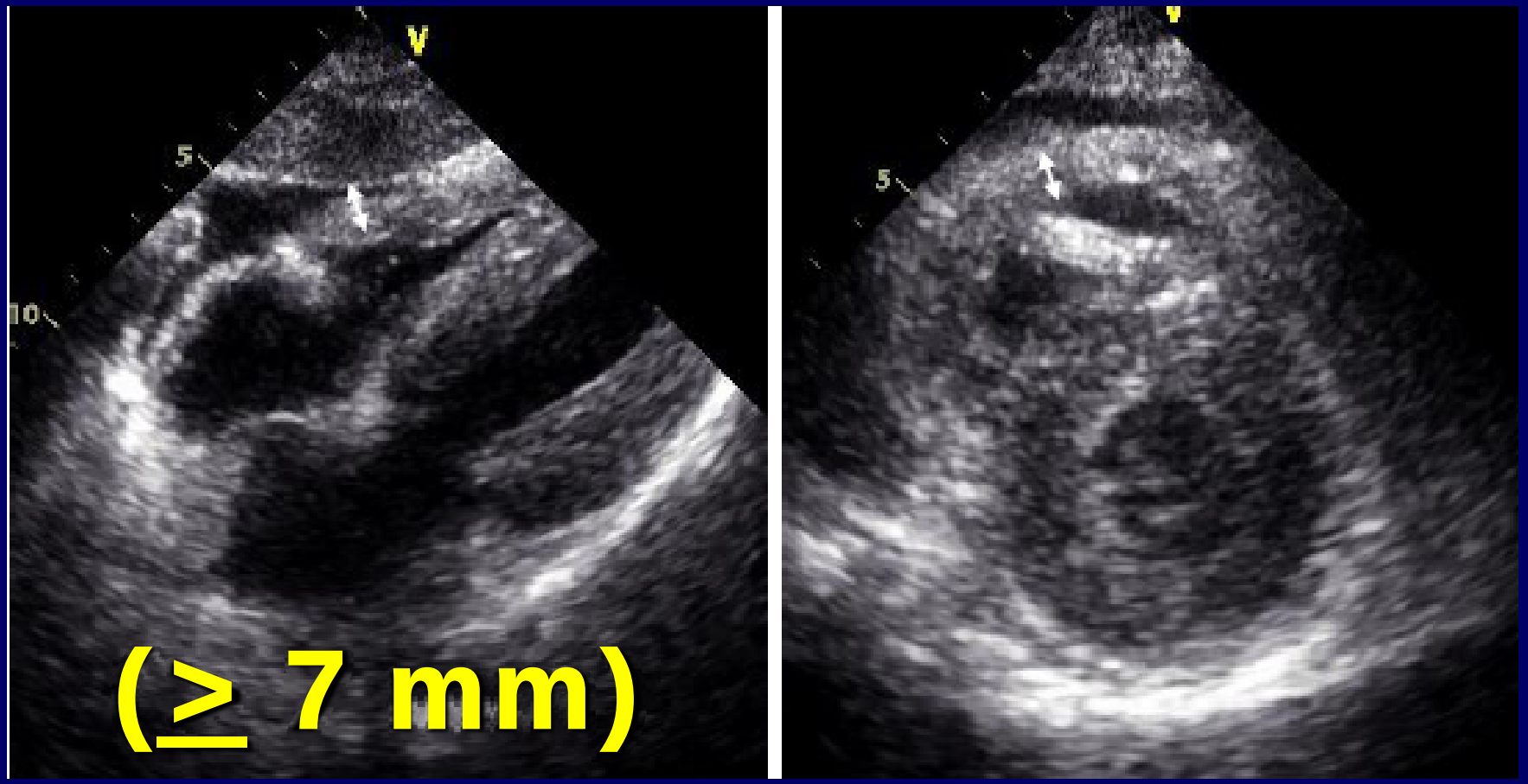
(exponential rise above 45 mm or 34 ml/cm²)



Time from initial HCM diagnosis (years)

Olivotto, Circulation 2001

Right ventricular hypertrophy



McKenna, JACC 1988

Apical HCM

Echo in HCM

Diagnosis

Prognosis

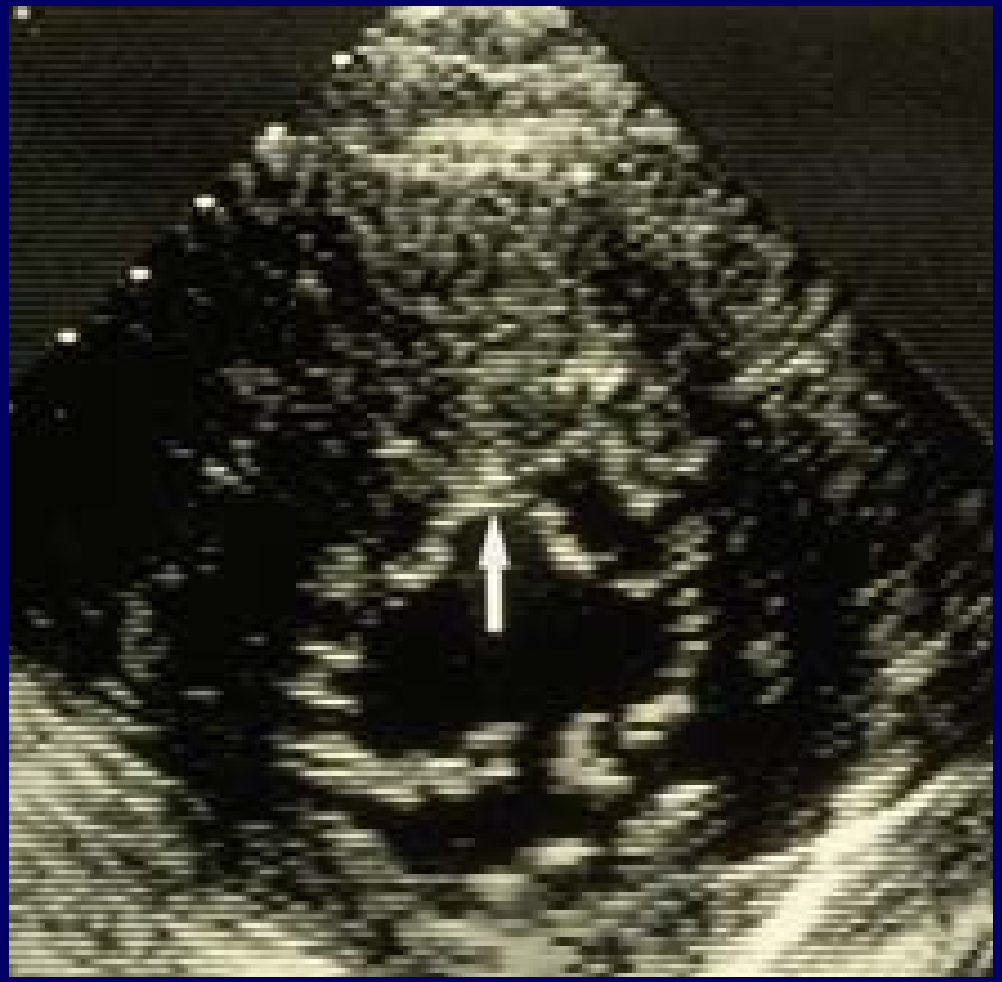
Therapeutics (obstruction)

Familial screening

1- Search / quantify obstruction

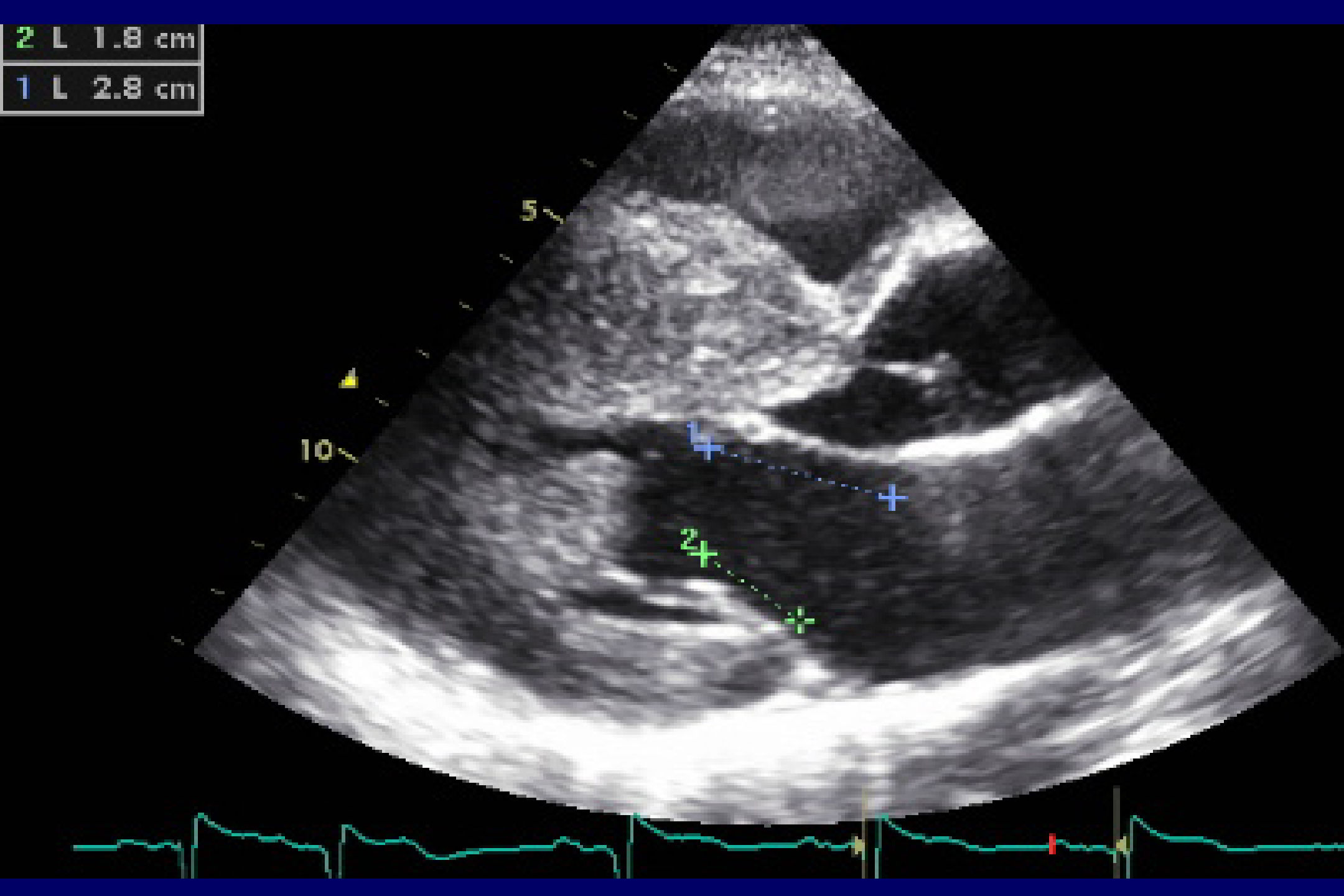
- At rest or provoked (post-VPB, standing, Valsalva, peak/post upright exercise)
- Location: outflow tract (SAM) or mid-LV
- Thresholds (peak Doppler gradient)
  - Significant = 30 mmHg
  - Discuss invasive therapies = 50 mmHg (50% pts)
- Variability : Time, alcohol, meals, drugs (30% decrease in 50%)

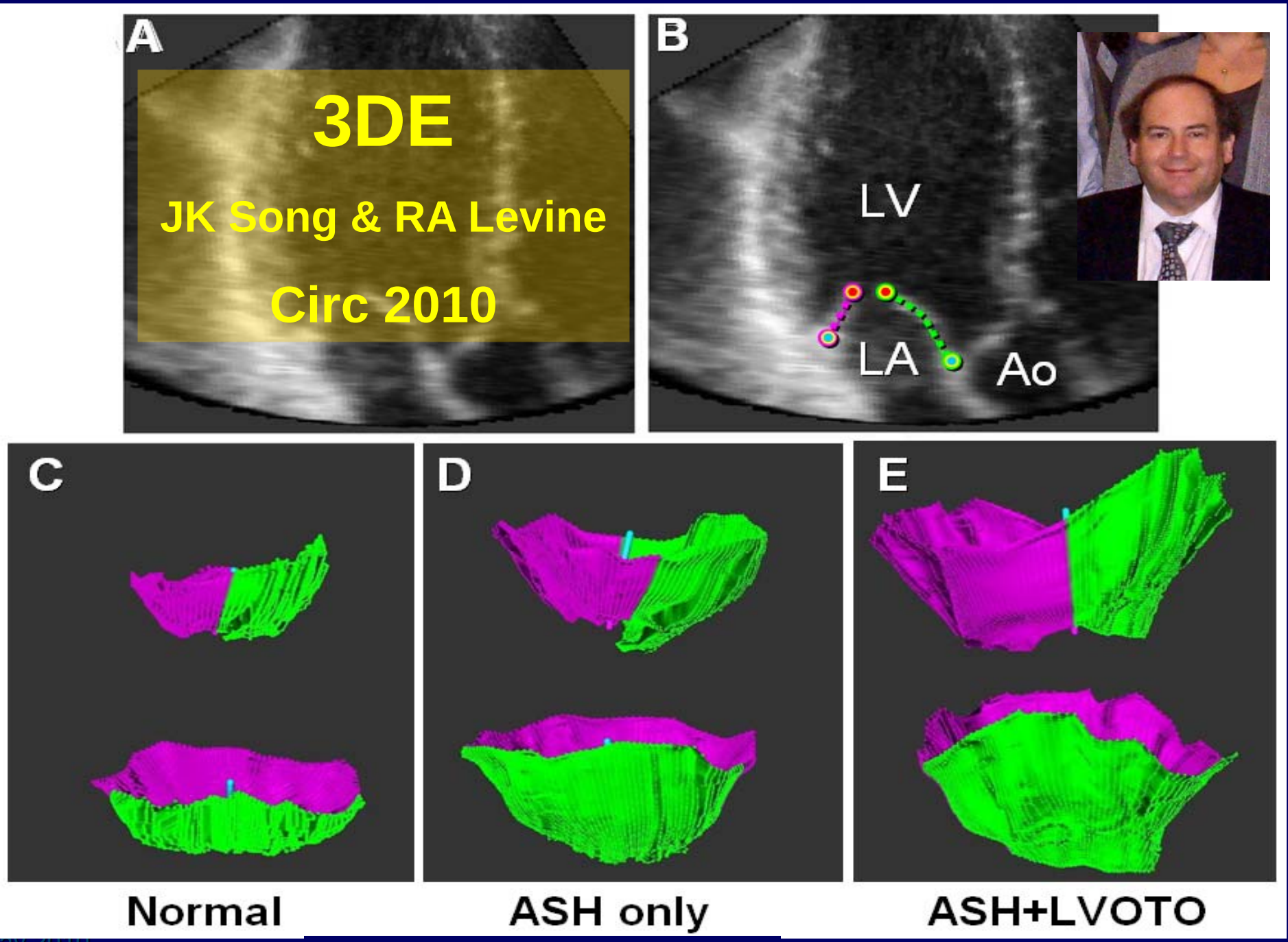
2- Describe leaflet SAM



3- Search for PM insertion abnormalities (up to 10%)

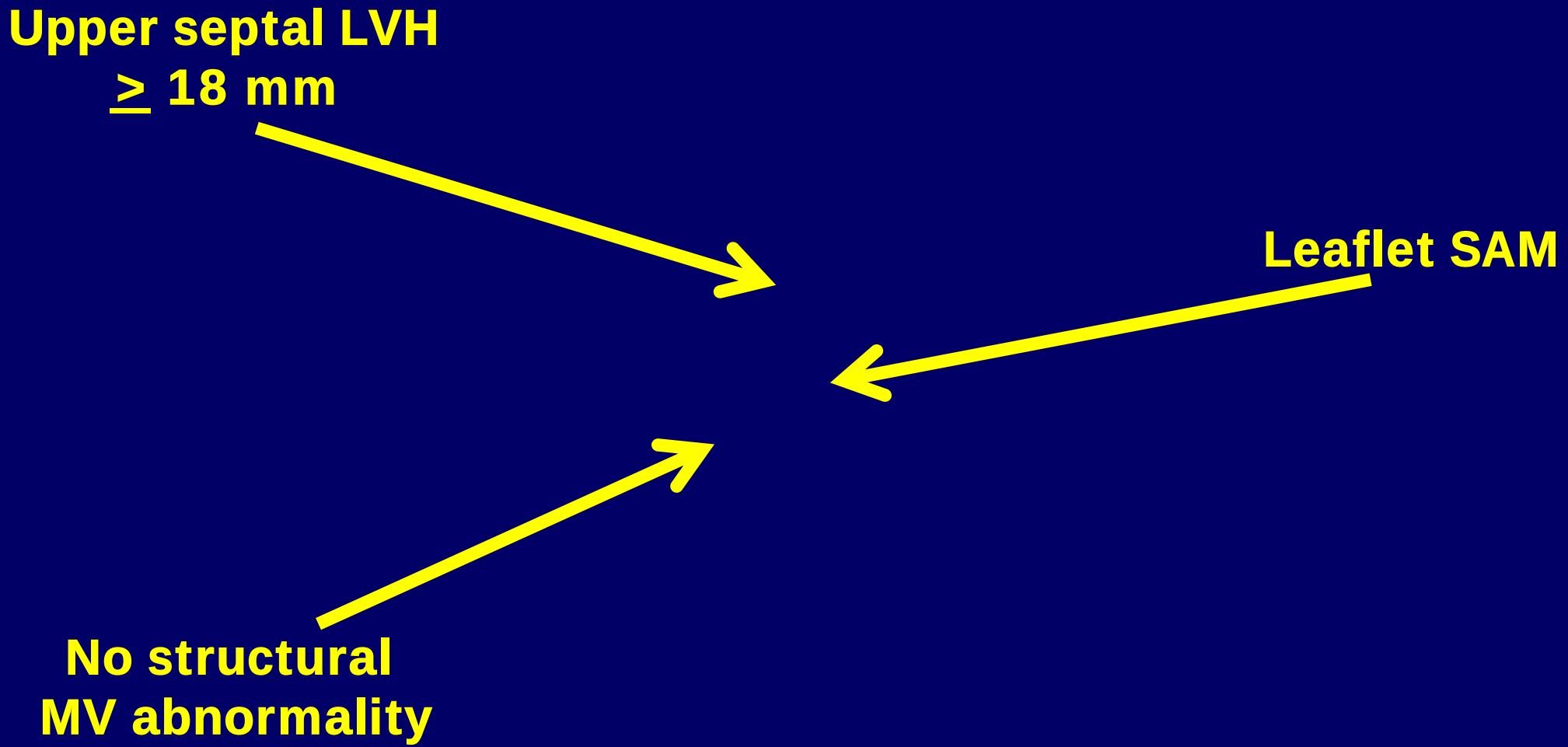
4- Quantify leaflet elongation *(> 50%)*


2 L 1.8 cm
1 L 2.8 cm
5
10
1
2

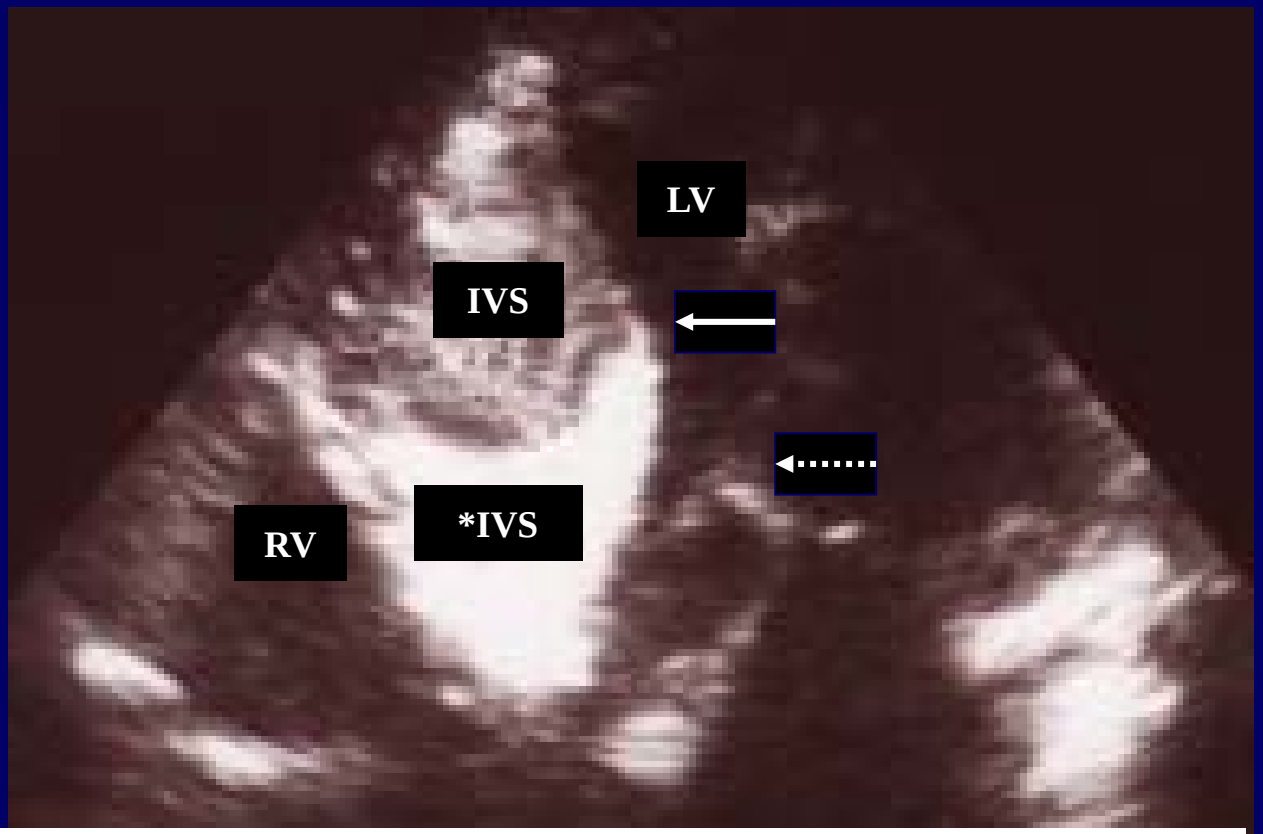

A
3DE
JK Song & RA Levine
Circ 2010
B
LV
LA
Ao
C
D
E
Normal
ASH only
ASH+LVOTO

5- Indication for TASH

(NYHA III, optimal drug therapy, LVOT ≥ 50 mmHg)



6- Contrast echo



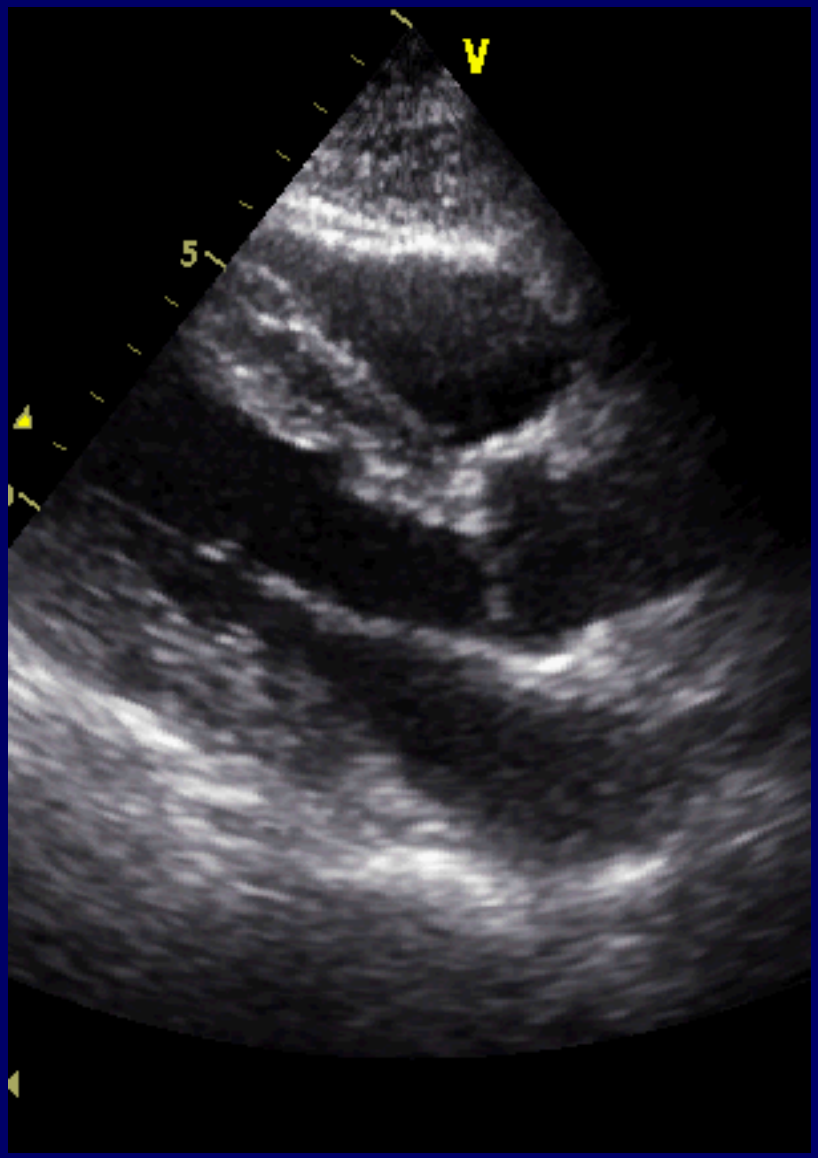
230 patients

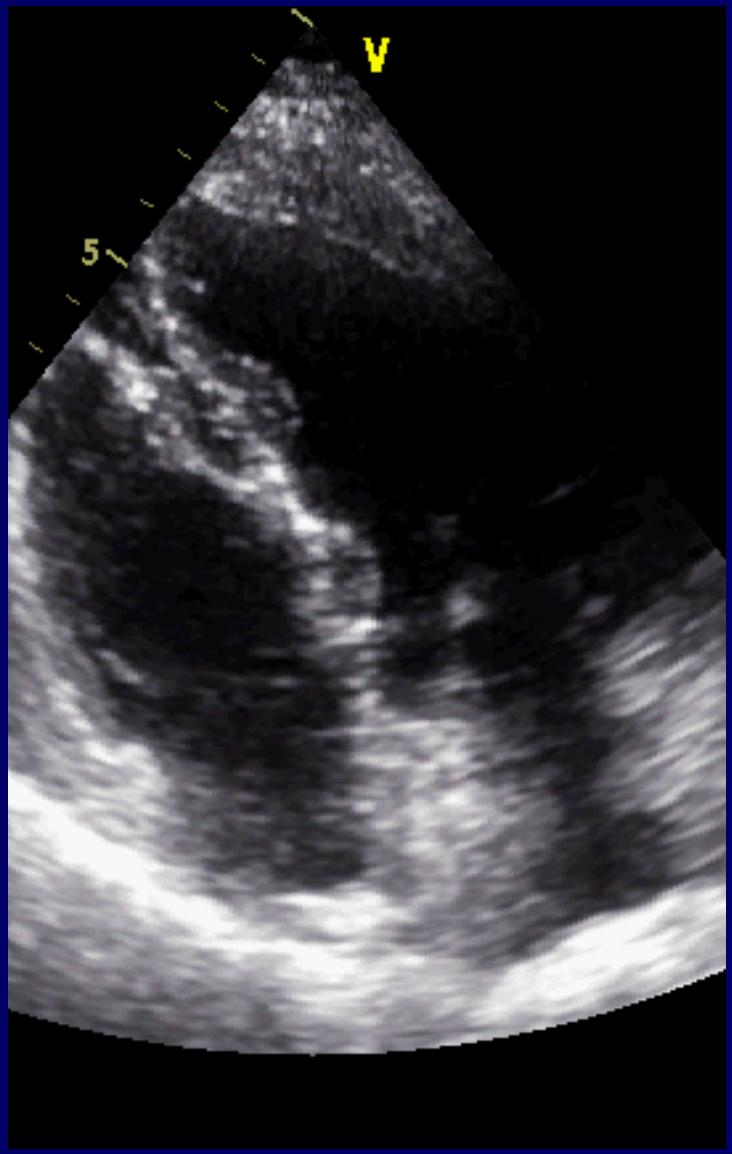
8.7%: 1st septal artery is not the target

5.2%: No target artery

Seggewiss, Curr Cardiol Rep 3:160-166, 2001

Echo post-TASH





Echo in HCM

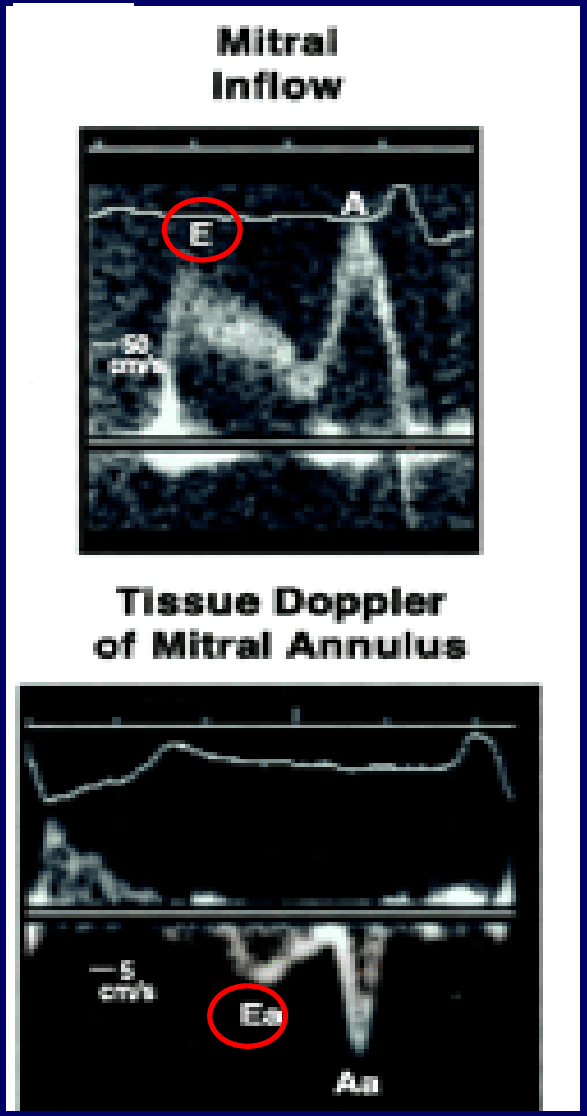
Diagnosis

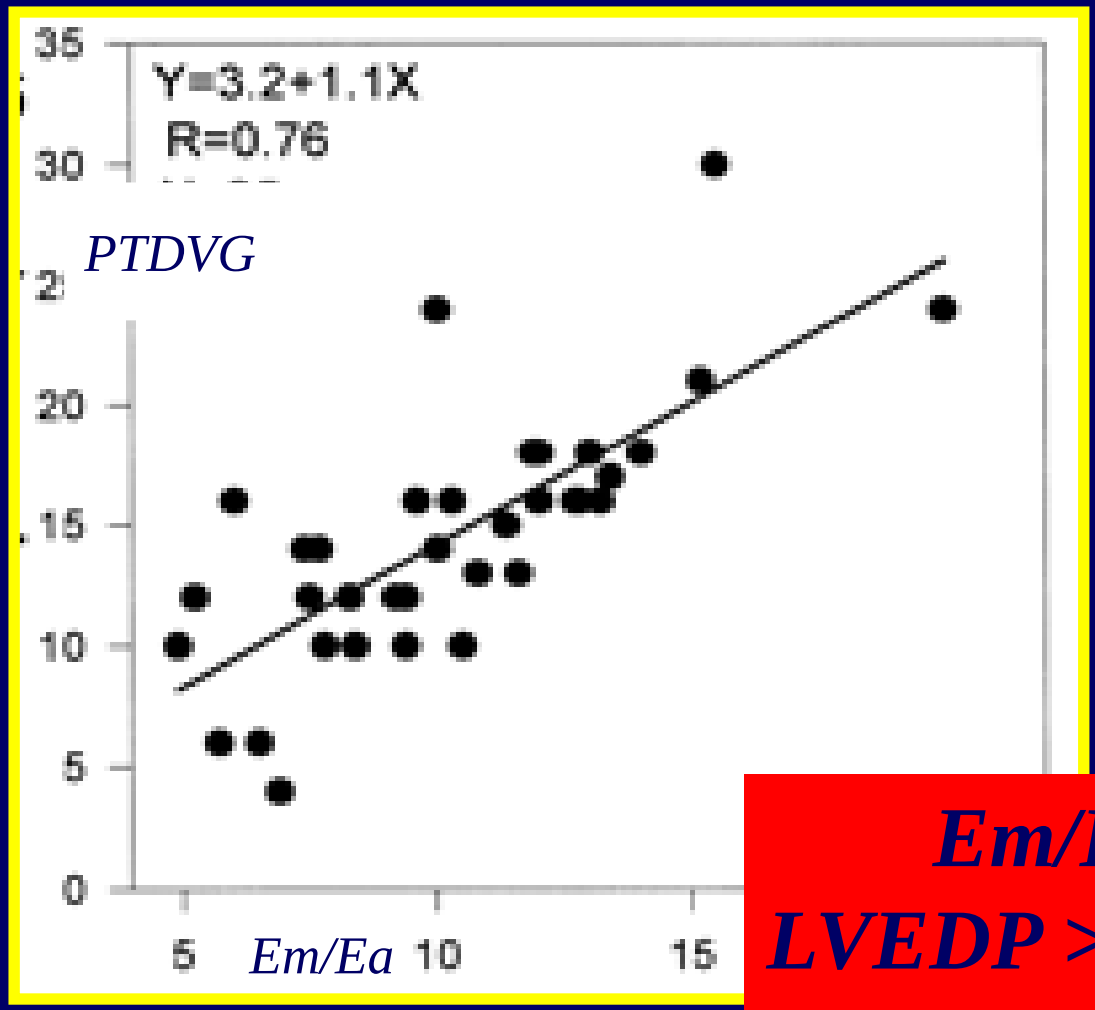
Prognosis

Therapeutics (LVEDP)

Familial screening

LVEDP





Em/Ea>12

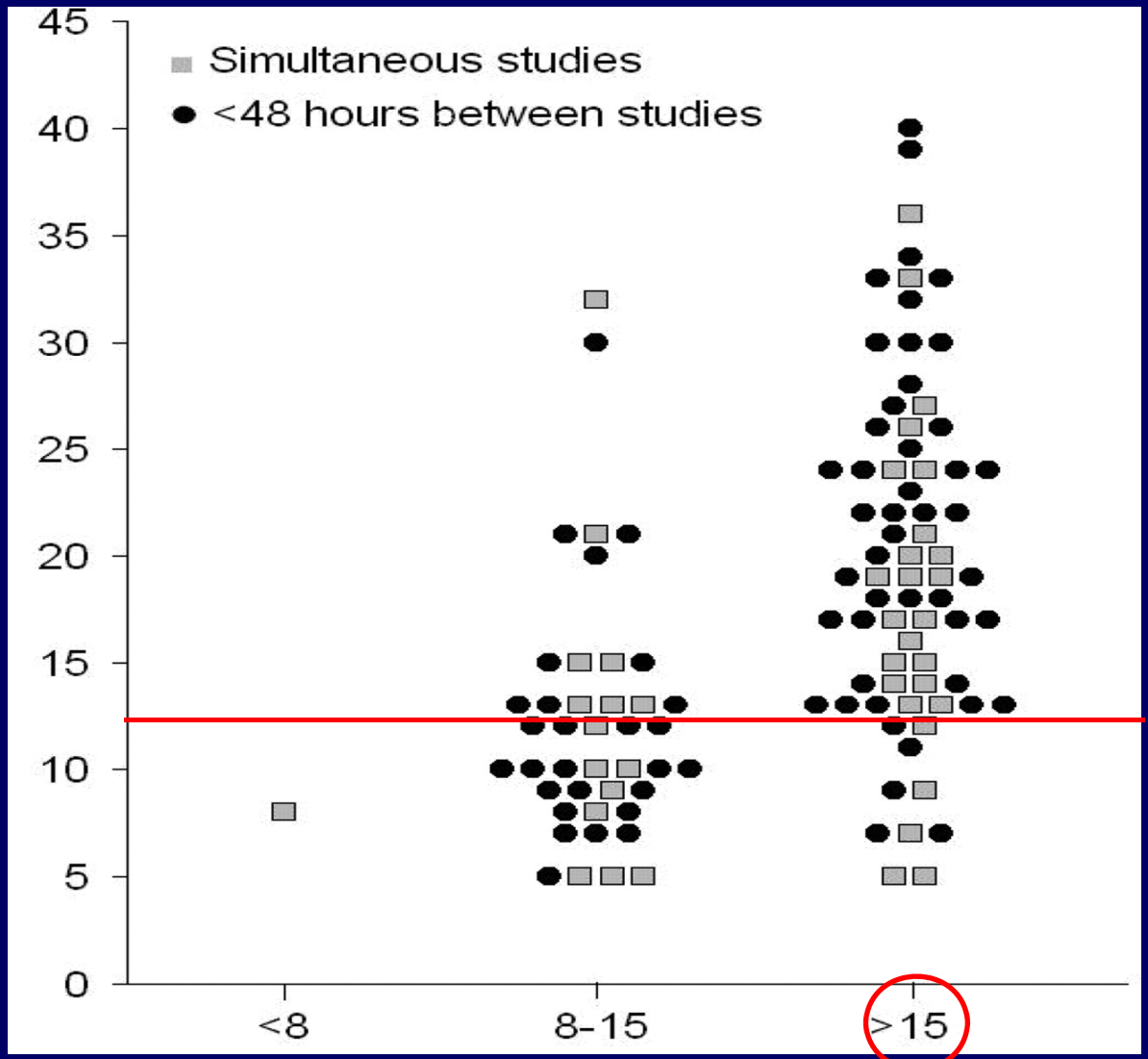
LVEDP > 15 mmHg

(Spe >90%, Se 60%)

Nagueh, Circulation 1999

LVEDP

Mean left atrial pressure (mmHg) ***(cath.)***



100 HCM pts
83% NYHA 3/4

Medial Em / Ea ***(Doppler)***

Geske, Circulation 2007;116:2702-8

Echo in HCM

Diagnosis

Prognosis

Therapeutics

Familial screening

(first degree relatives)

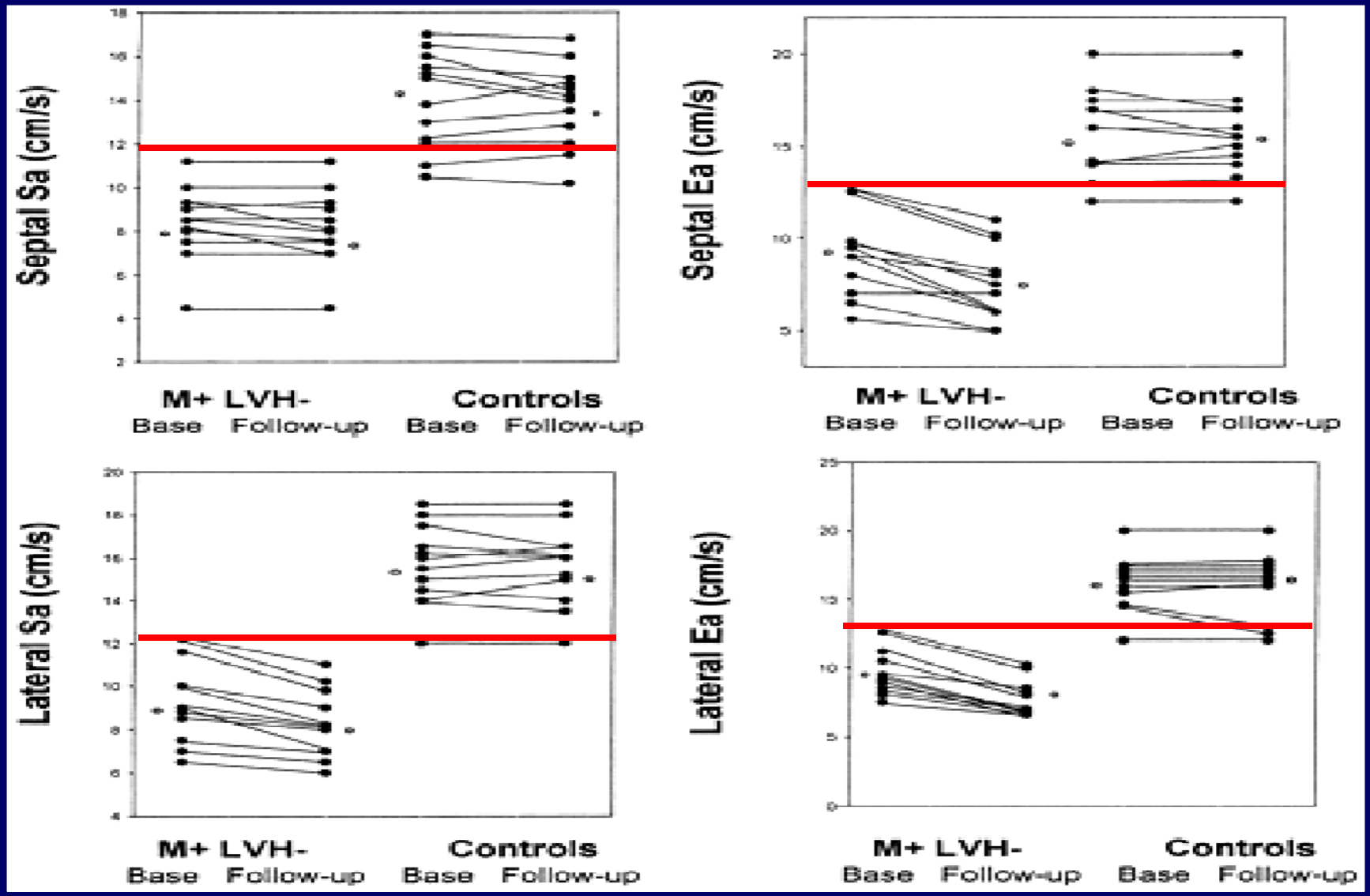
Criteria for HCM in first degree relatives

Diagnosis if 1 major OR 2 minor echographic
OR 1 minor echographic & 2 minor ECG criteria

Major criteria	Minor criteria
LV wall thickness ≥ 13 mm	**LV wall thickness = 12mm**
Severe SAM **(septal-leaflet contact)**	Moderate SAM (no contact)
	Redundant MV leaflets
LVH with Romhilt Estes score ≥ 4	Complete BBB or interventricular conduction defect (QRS ≥ 120 msec)
Abnormal Q waves (> 40 ms or >1/3 R wave in depth) in ≥ 2 leads	Deep S V2 (> 25mm)
T inversion (> 3mm) in ≥ 2 leads in the absence of BBB or hemiblock	Minor repolarisation changes

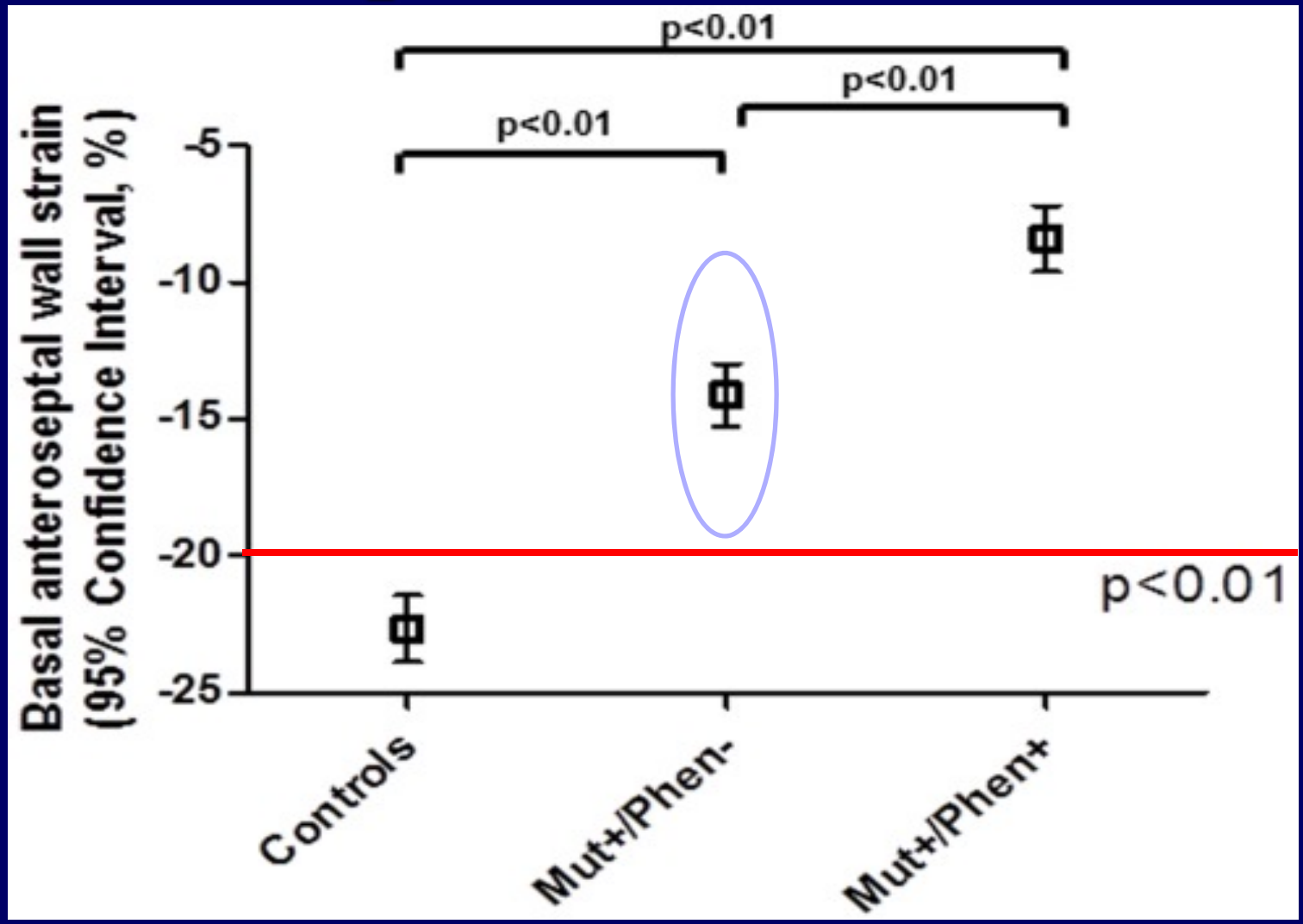
McKenna, Heart 1997;77:130-2

Prediction of LVH ocurence at 2 yrs
DTI velocities < 12cm/s at mitral annulus



Nagueh, Circulation. 2003;108:395

Septal strain



Yiu, PLoS One. 2012; 7(5): e36115

Family screening
ECG & echo

- Before 12 yrs : Optional
- 12 to 18-21 yrs* : 12-18 months interval
- After 21 yrs : 3-5 yrs interval
- Systematic & early (5 yrs) if
  - Symptoms
  - Family history of SCD
  - Competitive sports

Echo remains a major tool in HCM