

# **CARDIOMYOPATHIES CASES**

## **HYPERTROPHIC CARDIOMYOPATHY**

**1. SCD ASSESSEMENT ACCORDING TO THE AHA AND ESC GUIDELINES; TREATMENT OF SYMPTOMATIC PATIENTS WITHOUT TYPICAL OBSTRUCTION OF THE LEFT VENTRICULAR OUTFLOW TRACT**

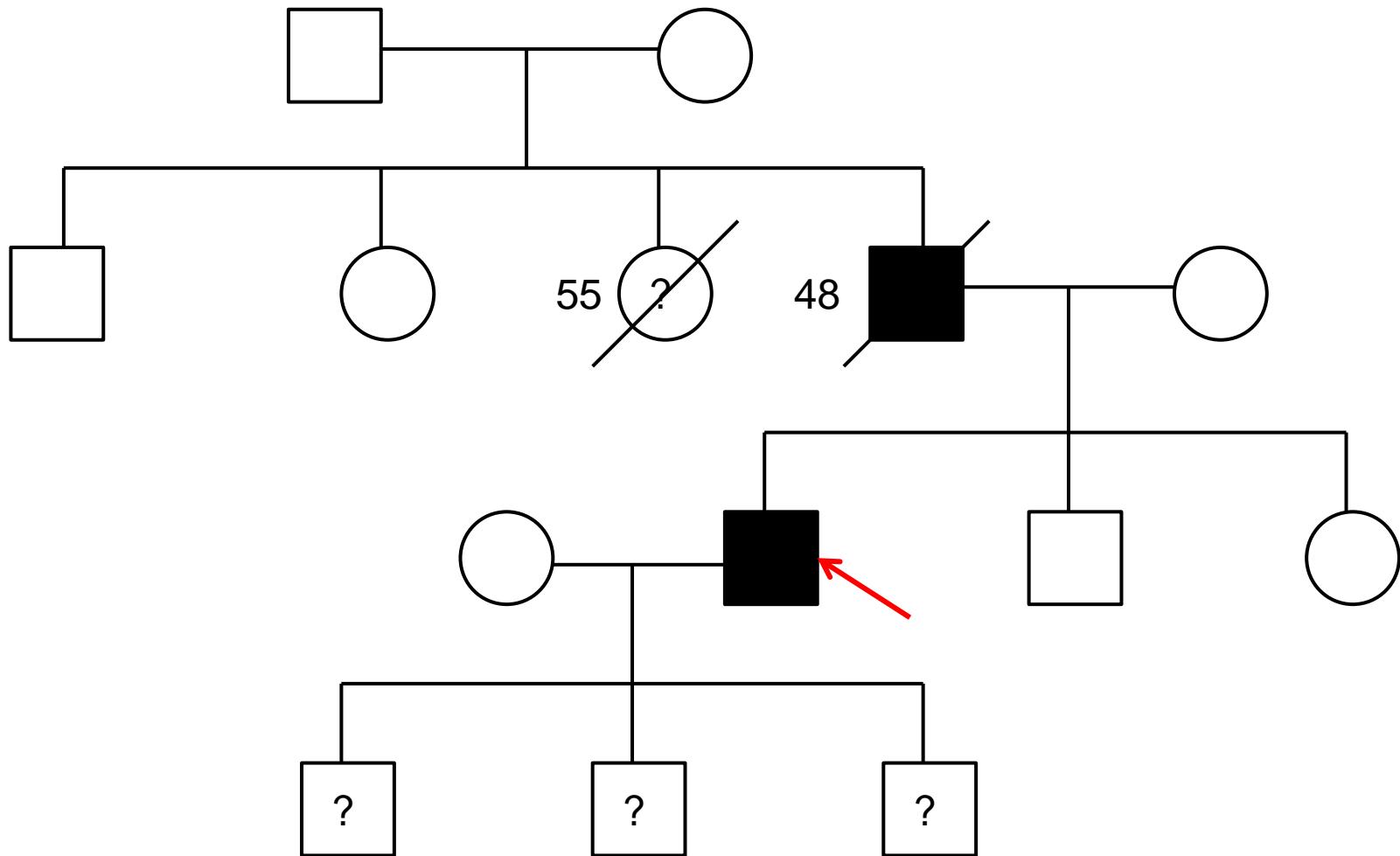
**1. SCD RISK IN GENOTYPE POSITIVE – PHENOTYPE NEGATIVE SUBJECTS**



# CASE No 1: CLINICAL HISTORY

- 41 - year old male patient with palpitations referred for risk assessment for SCD / AICD insertion; currently symptomatic with SOB; NYHA functional class II – III
- first diagnosis of HCM in 1996 at the age of 23; family screening (father with known HCM)
- until 2004 regular FU-exams in Berlin; then patient moved to Switzerland, no further FU exams, patient was asymptomatic
- August 2014 increasing exercise intolerance; cardiologist; start on **Verapamil and Torasemid** due to diastolic dysfunction
- November 2011 regional hospital: coronary angiography showed normal coronary arteries; midventricular obstruction; LVEDP 26mmHg; mean PAP 28mmHg. **Bisoprolol** was added.

# CASE No 1: FAMILY HISTORY



# CASE No 1: EKG

Geb: 24.03.1973  
Alter: 41 Jahre  
Geschl: M  
Grösse: 181.0 cm  
Gewicht: 109.0 kg  
BD: - / - mmHg

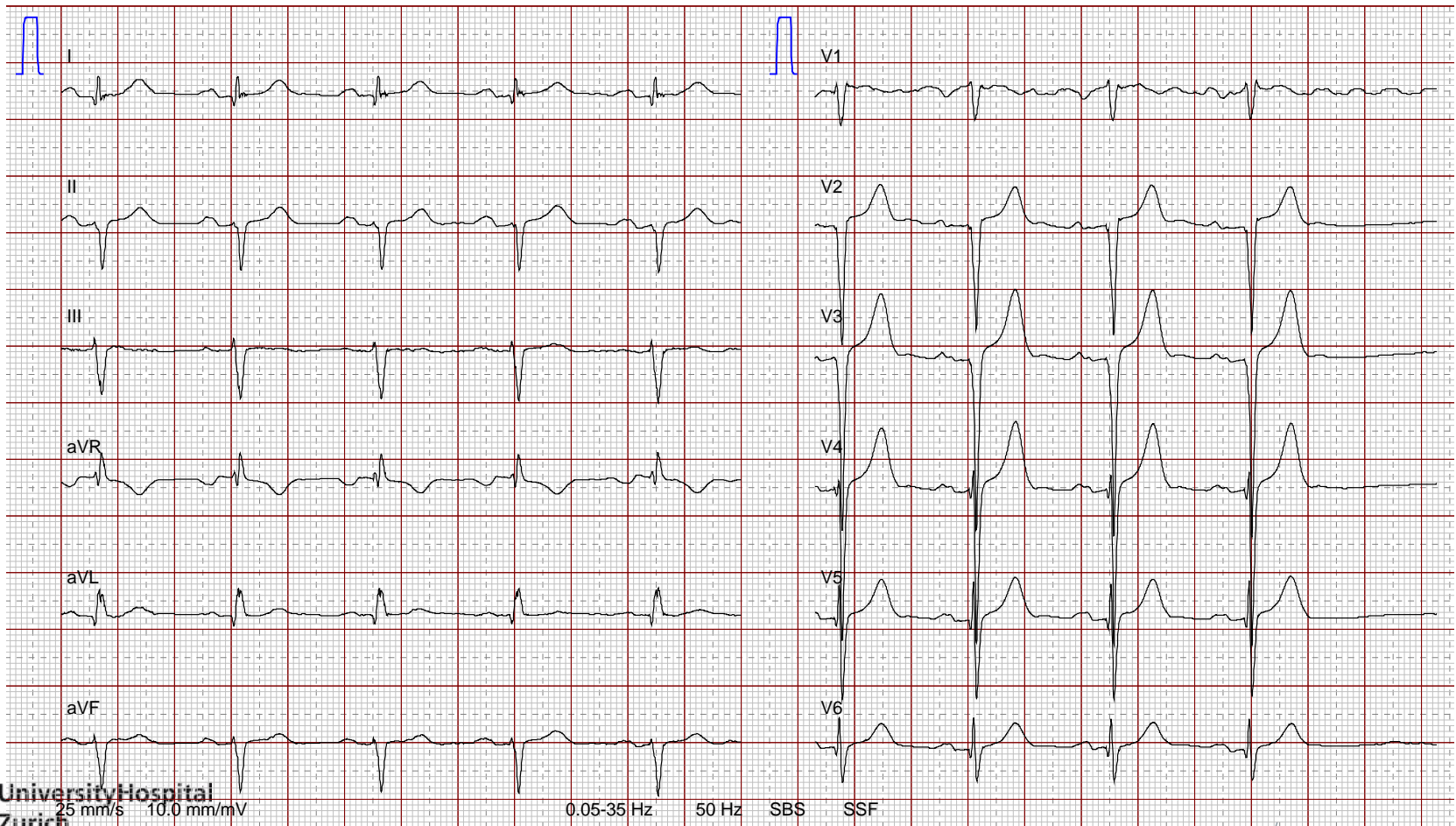
HF 61 /min  
Achsen  
P 42°  
QRS -77°  
T 36°

Intervalle  
RR 974 ms  
P 132 ms  
PQ 226 ms  
QRS 104 ms  
QT 440 ms  
QTc 446 ms

Interpretation

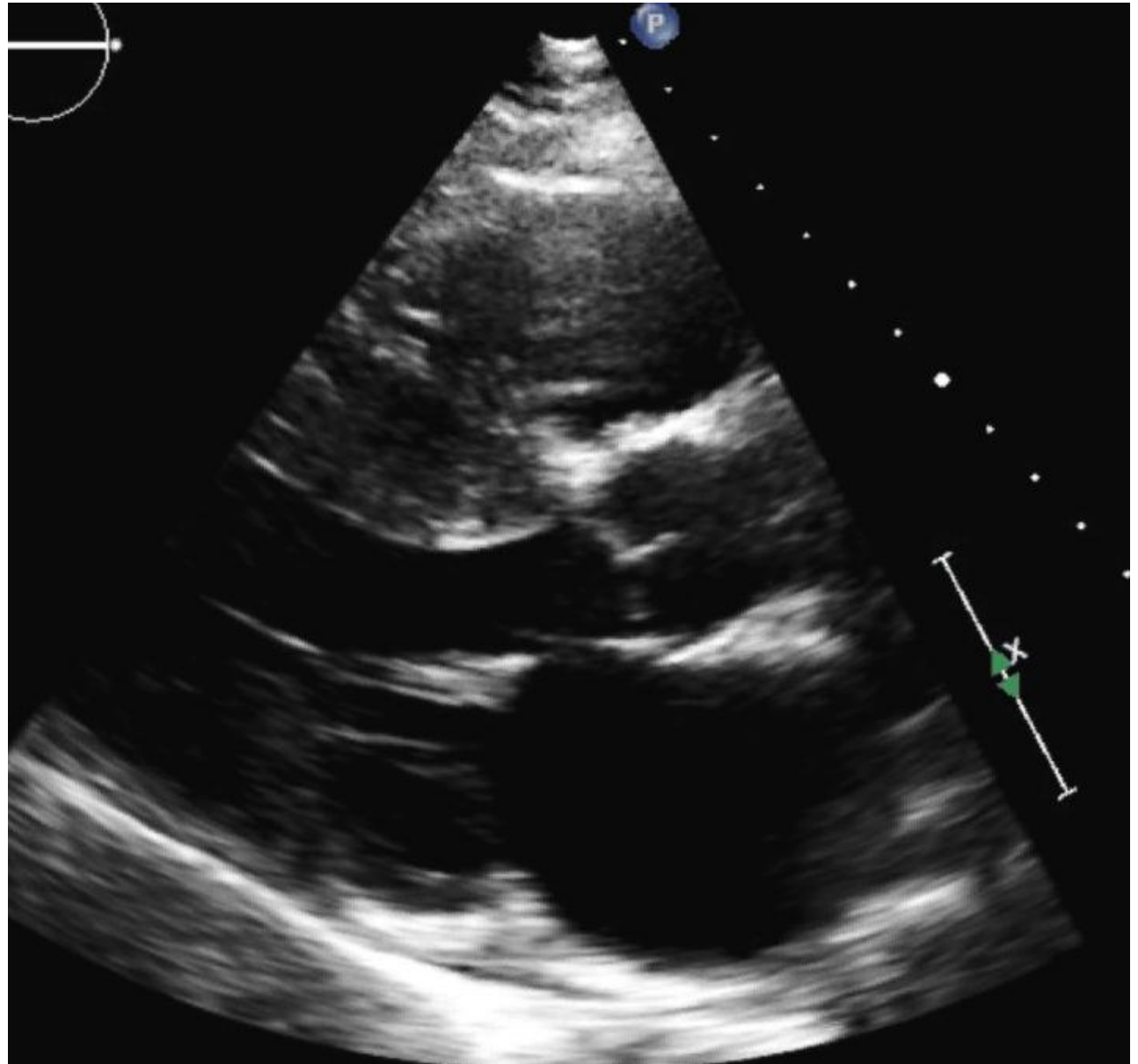
Med:  
Bem:

Validiert von



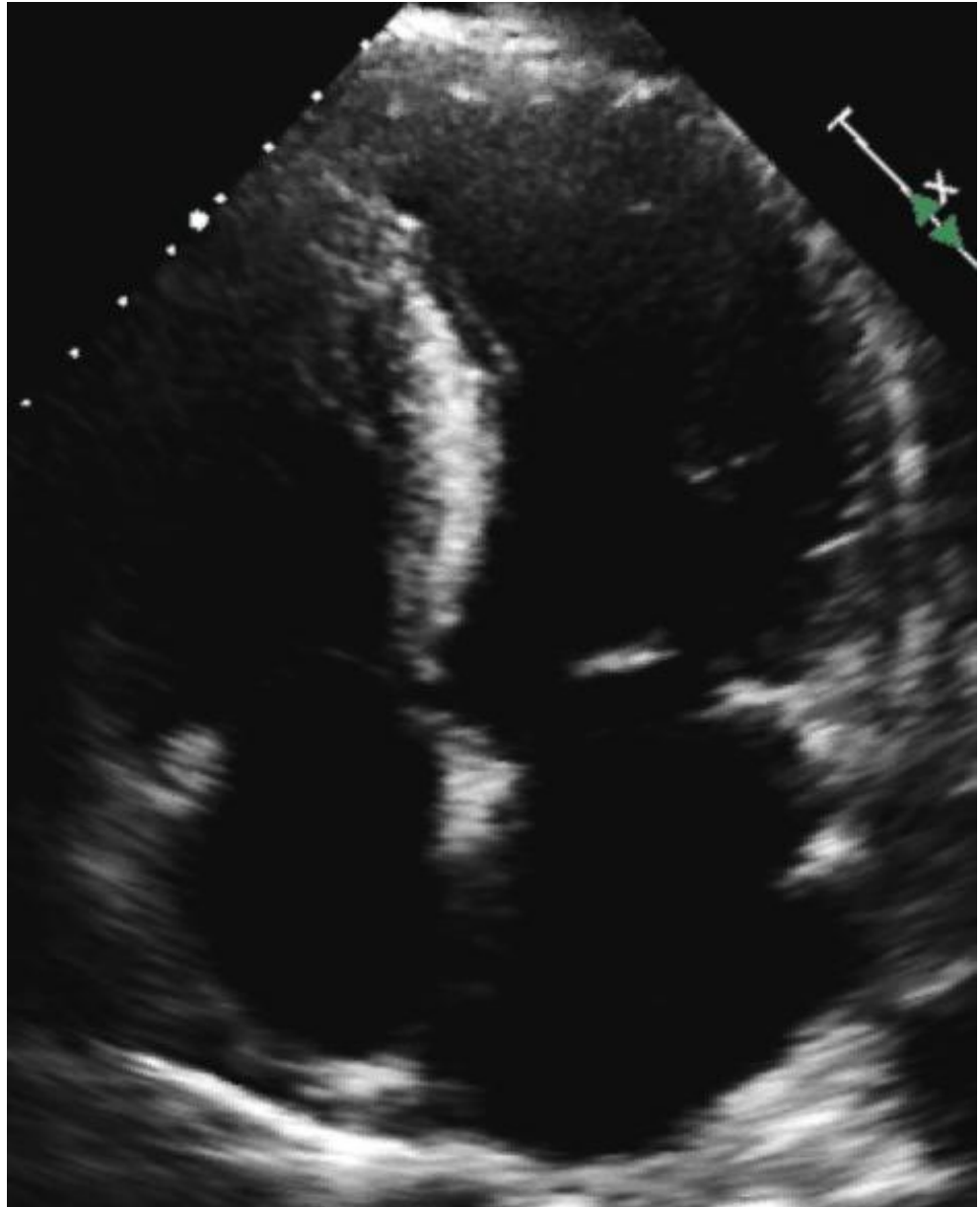
## CASE No 1: ECHOCARDIOGRAPHY

- IVS 27mm
- no SAM

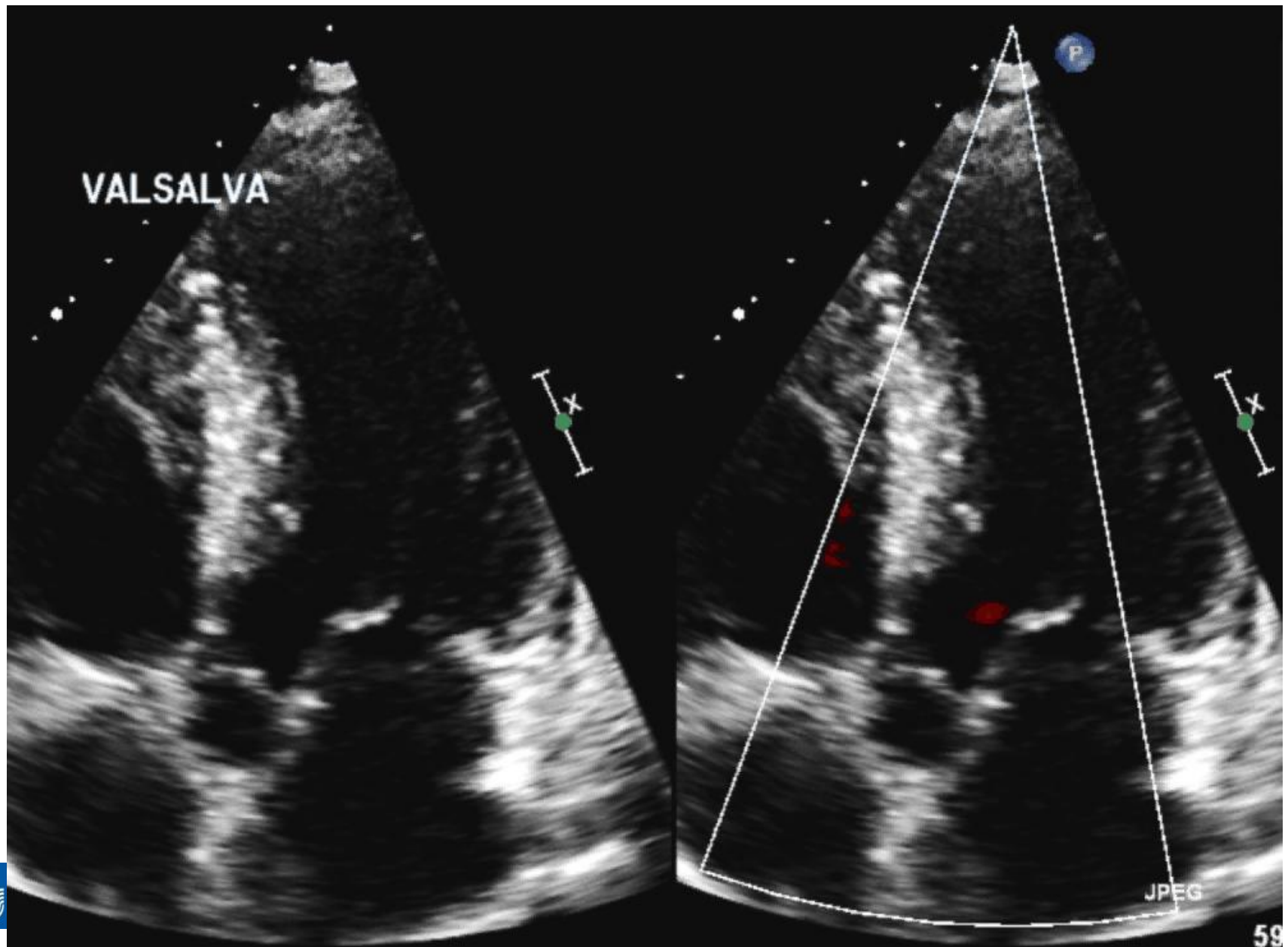


## CASE No 1: ECHOCARDIOGRAPHY

- Ejection fraction 60%
- Apical and midventricular cavity obliteration
- LAVi 65ml/m<sup>2</sup>
- Mild MR

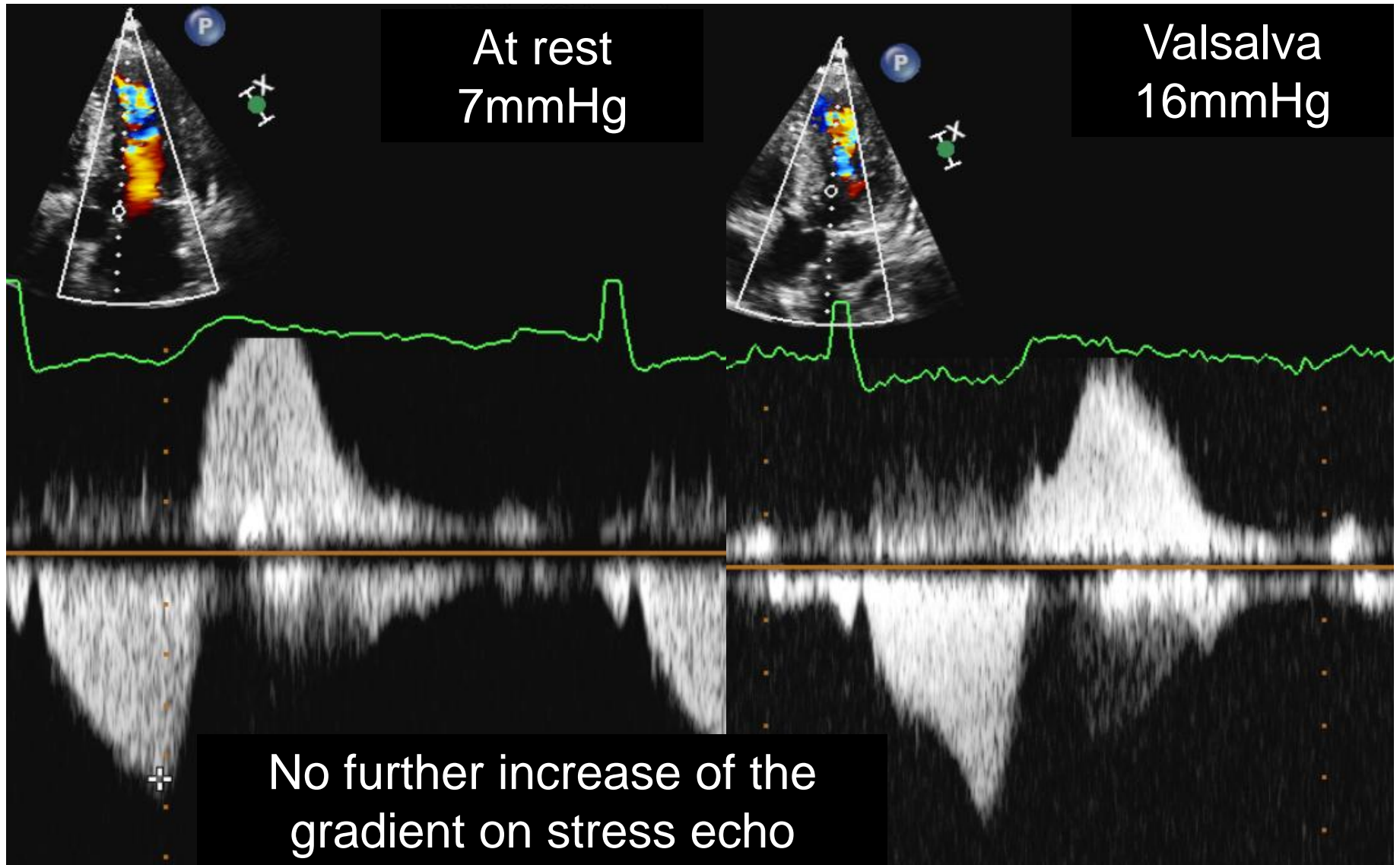


## CASE No 1: ECHOCARDIOGRAPHY





## CASE No 1: ECHOCARDIOGRAPHY





## CASE No 1: CMR

**5% LGE**



## CASE No 1: FURTHER INVESTIGATIONS

- **HOLTER MONITOR:** nsVTs (7 beats at 180/min.)
- **EXERCISE STRESS TEST:** 172 Watt (75% predicted); blood pressure at rest 139/92mmHg, BP at peak exercise 211/96mmHg; HR at rest 70/min. at peak exercise 136/min.

# **HYPERTROPHIC CARDIOMYOPATHY: RISK STRATIFICATION FOR SUDDEN CARDIAC DEATH**

## **Indications For ICD**

- **Aborted sudden death**
- **Sustained VT**

## **Major Risk Factors**

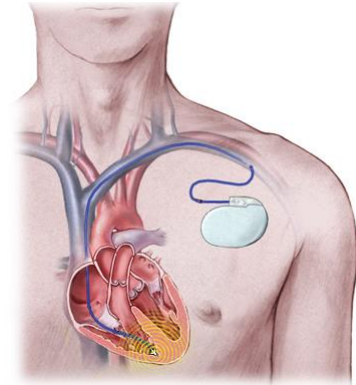
- **LV wall thickness 30mm or greater**
- **First degree family member SCD**
- **Recent unexplained syncope**

## **Minor Risk Factors**

- **Abnormal BP response to exercise**
- **Non sustained VT on Holter**

## **Modifiers**

- **CMR: LGE**
- **LVOT obstruction**
- **Apical LV aneurysm**
- **Genetic mutations (double and compound)**



**Table 7 Major clinical features associated with an increased risk of sudden cardiac death in adults**

Risk Factor	Comment
Age	<ul style="list-style-type: none"> <li>The effect of age on SCD has been examined in a number of studies<sup>73,82,99,208,244,373-374</sup> and two have shown a significant association, with an increased risk of SCD in younger patients.<sup>73,99</sup></li> <li>Some risk factors appear to be more important in younger patients, most notably, NSVT,<sup>69</sup> severe LVH<sup>375</sup> and unexplained syncope.<sup>99</sup></li> </ul>
Non-sustained ventricular tachycardia	<ul style="list-style-type: none"> <li>NSVT (defined as <math>\geq 3</math> consecutive ventricular beats at <math>\geq 120</math> BPM lasting <math>&lt; 30</math> seconds) occurs in 20–30% of patients during ambulatory ECG monitoring and is an independent predictor of SCD.<sup>69,73,83,246,248,374</sup></li> <li>There is no evidence that the frequency, duration or rate of NSVT influences the risk of SCD.<sup>69,376</sup></li> </ul>
Maximum left ventricular wall thickness	<ul style="list-style-type: none"> <li>The severity and extent of LVH measured by TTE are associated with the risk of SCD.<sup>69,120,121,373</sup></li> <li>Several studies have shown the greatest risk of SCD in patients with a maximum wall thickness of <math>\geq 30</math> mm but there are few data in patients with extreme hypertrophy (<math>\geq 35</math> mm).<sup>69,73,120,247,248,373,377,378</sup></li> </ul>
Family history of sudden cardiac death at a young age	<ul style="list-style-type: none"> <li>While definitions vary,<sup>73,120,372,377</sup> a family history of SCD is usually considered clinically significant when one or more first-degree relatives have died suddenly aged <math>&lt; 40</math> years with or without a diagnosis of HCM, or when SCD has occurred in a first-degree relative at any age with an established diagnosis of HCM.</li> </ul>
Syncope	<ul style="list-style-type: none"> <li>Syncope is common in patients with HCM but is challenging to assess as it has multiple causes.<sup>379</sup></li> <li>Non-neurocardiogenic syncope for which there is no explanation after investigation is associated with increased risk of SCD.<sup>73,83,99,244,246-248</sup></li> <li>Episodes within 6 months of evaluation may be more predictive of SCD.<sup>99</sup></li> </ul>
Left atrial diameter	<ul style="list-style-type: none"> <li>Two studies have reported a positive association between LA size and SCD.<sup>73,99</sup> There are no data on the association between SCD and LA area and volume. Measurement of LA size is also important in assessing the risk of AF (see section 9.4).</li> </ul>
Left ventricular outflow tract obstruction	<ul style="list-style-type: none"> <li>A number of studies have reported a significant association with LVOTO and SCD.<sup>73,82,83,246,372,380</sup> Several unanswered questions remain, including the prognostic importance of provokable LVOTO and the impact of treatment (medical or invasive) on SCD.</li> </ul>
Exercise blood pressure response	<ul style="list-style-type: none"> <li>Approximately one third of adult patients with HCM have an abnormal systolic blood pressure response to exercise characterised by progressive hypotension or a failure to augment the systolic blood pressure that is caused by an inappropriate drop in systemic vascular resistance and a low cardiac output reserve.<sup>241,381</sup></li> <li>Various definitions for abnormal blood pressure response in patients with HCM have been reported<sup>69,83,246,377</sup>; for the purposes of this guideline an abnormal blood pressure response is defined as a failure to increase systolic pressure by at least 20 mm Hg from rest to peak exercise or a fall of <math>&gt; 20</math> mm Hg from peak pressure.<sup>237</sup></li> <li>Abnormal exercise blood pressure response is associated with a higher risk of SCD in patients aged <math>\leq 40</math> years,<sup>237</sup> but its prognostic significance in patients <math>&gt; 40</math> years of age is unknown.</li> </ul>

HCM = hypertrophic cardiomyopathy; LA = left atrium; LVH = left ventricular hypertrophy; LVOTO = left ventricular outflow tract obstruction; NSVT = non-sustained ventricular tachycardia; SCD = sudden cardiac death; TTE = transthoracic echocardiography.

# HYPERTROPHIC CARDIOMYOPATHY: RISK STRATIFICATION FOR SUDDEN CARDIAC DEATH

$$\text{Probability}_{\text{SCD at 5 years}} = 1 - 0.998^{\exp(\text{Prognostic index})}$$

where Prognostic index =  $[0.15939858 \times \text{maximal wall thickness (mm)}] - [0.00294271 \times \text{maximal wall thickness}^2 \text{ (mm}^2)] + [0.0259082 \times \text{left atrial diameter (mm)}] + [0.00446131 \times \text{maximal (rest/Valsalva) left ventricular outflow tract gradient (mm Hg)}] + [0.4583082 \times \text{family history SCD}] + [0.82639195 \times \text{NSVT}] + [0.71650361 \times \text{unexplained syncope}] - [0.01799934 \times \text{age at clinical evaluation (years)}]$ .

## LOW RISK

5-YEAR RISK <4%

ICD GENERALLY NOT  
INDICATED

## INTERMEDIATE RISK

5-YEAR RISK 4% - <6%

ICD MAY BE  
CONSIDERED

## INTERMEDIATE RISK

5-YEAR RISK  $\geq 6\%$

ICD SHOULD BE  
CONSIDERED

# **HYPERTROPHIC CARDIOMYOPATHY: RISK STRATIFICATION FOR SUDDEN CARDIAC DEATH**

## **ESC 2014**

- Maximal wall thickness
- LAD (not indexed to BSA)
- LVOT gradient
- FH SCD
- nsVTs
- Unexplained syncope
- Age at clinical evaluation

## **AHA 2011**

- Maximal wall thickness
- FH SCD
- Unexplained syncope
- nsVTs
- Abnormal blood pressure response

### **Modifiers**

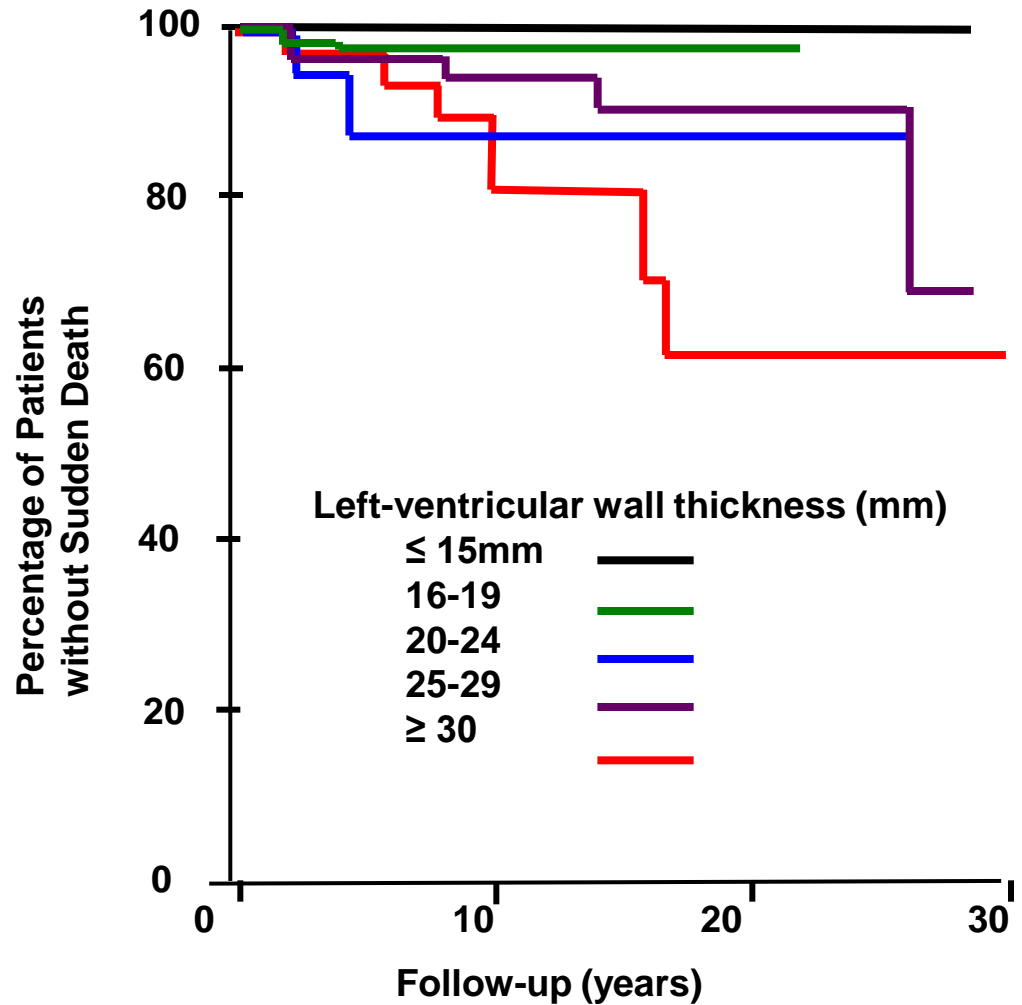
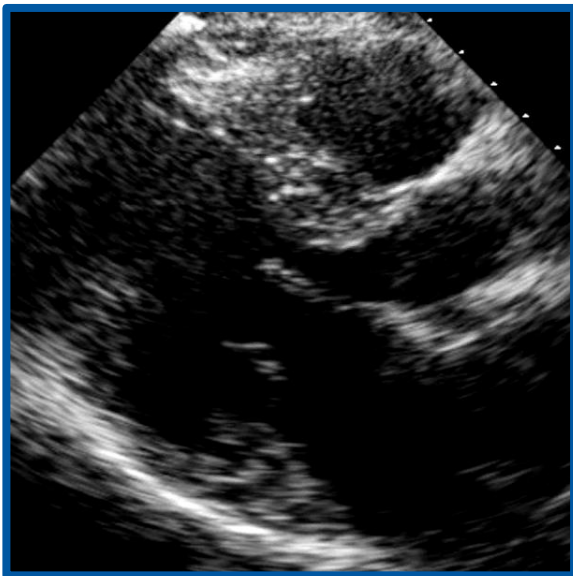
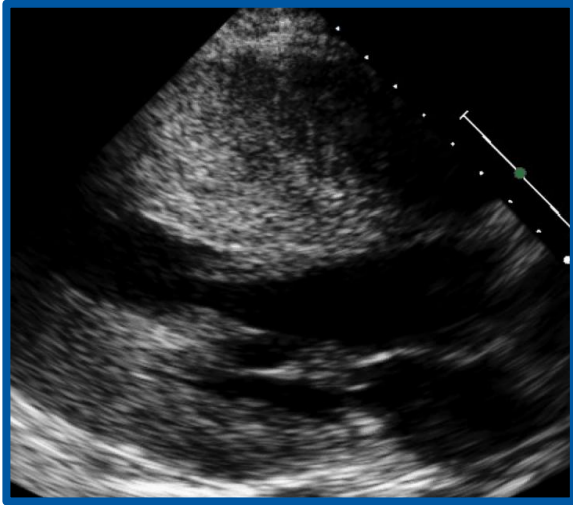
- LVEF <50%
- LGE on cardiac MRI
- Apical aneurysm
- Double mutations

# CASE No 1: SCD RISK STRATIFICATION

- **MAXIMAL WALL THICKNESS 27mm**

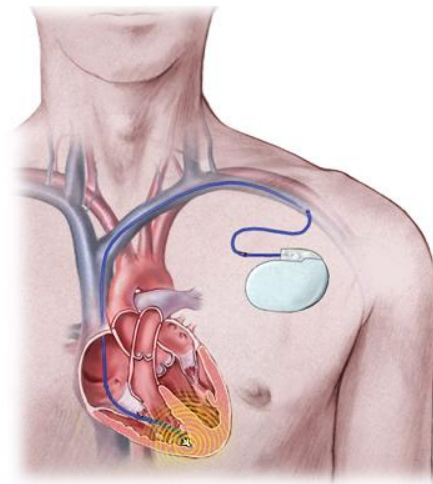


# HYPERTROPHIC CARDIOMYOPATHY: SCD: LEFT-VENTRICULAR HYPERTROPHY



# CASE No 1: SCD RISK STRATIFICATION

- **MAXIMAL WALL THICKNESS 27mm**
- **NSVTs ON HOLTER ECG**
- **5% LGE ON CARDIAC MRI**
- **ESC 5 YEARS RISK SCORE: 8%**



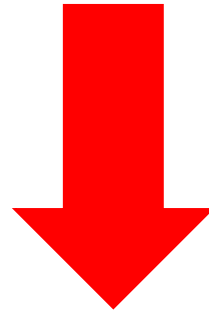
# CASE No 1: QUESTIONS TO THE EXPERTS

1. What is your assessment regarding SCD risk of this patient and ICD insertion for primary prophylaxis of SCD?
1. What is your opinion regarding the new ESC SCD risk calculator?

## CASE No 1: APPROACH TO PATIENTS' SYMPTOMS

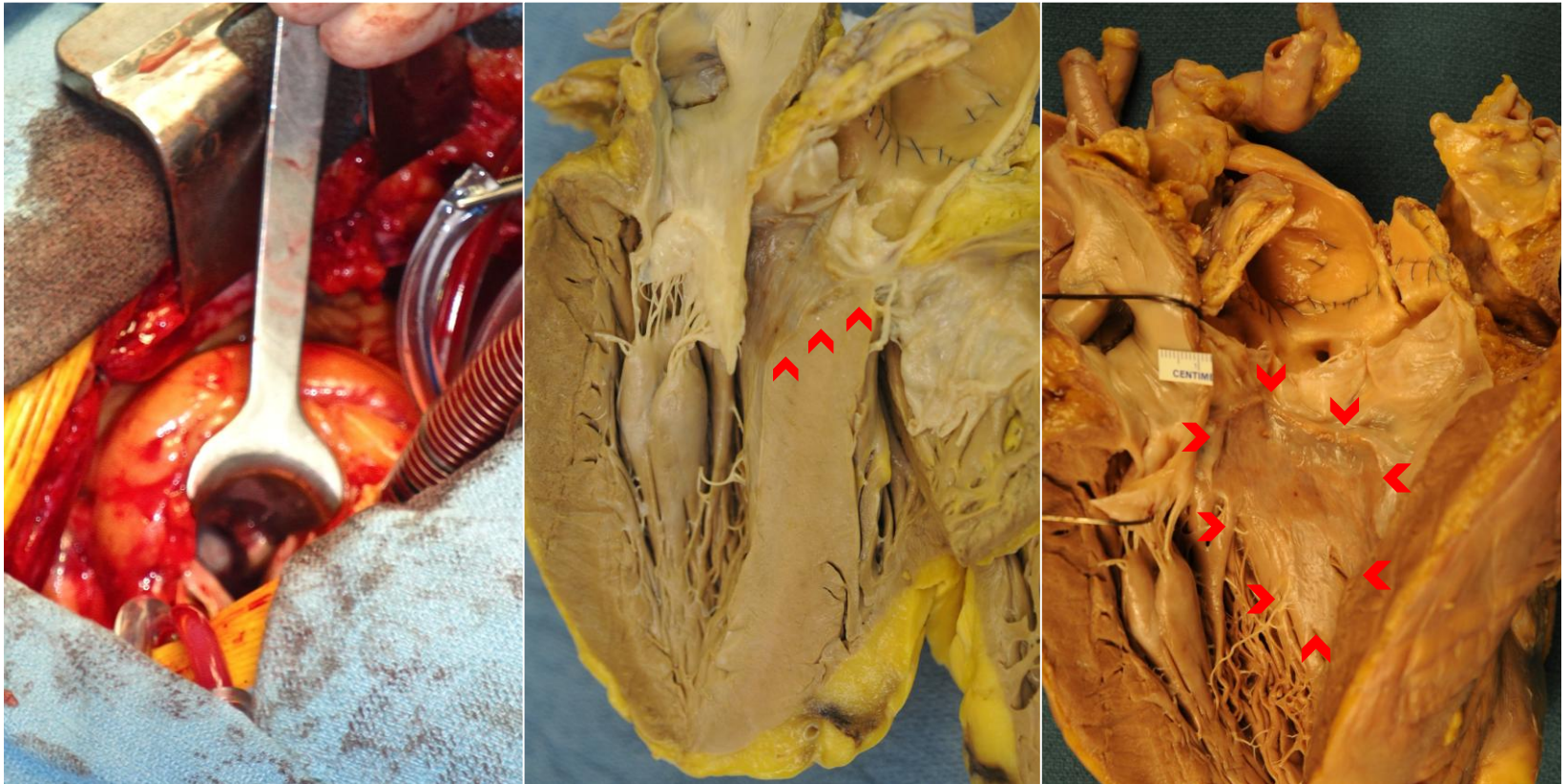
- Patient is in NYHA class II-III, currently under treatment with Verapamil 240mg, Bisoprolol 2.5mg and Torasemid 10mg
- Diastolic dysfunction, microvascular dysfunction, mild midventricular obstruction

### QUESTIONS TO THE EXPERTS



1. Trial with Ranolazine or Perhexiline despite absence of angina?
2. Apical myectomy?

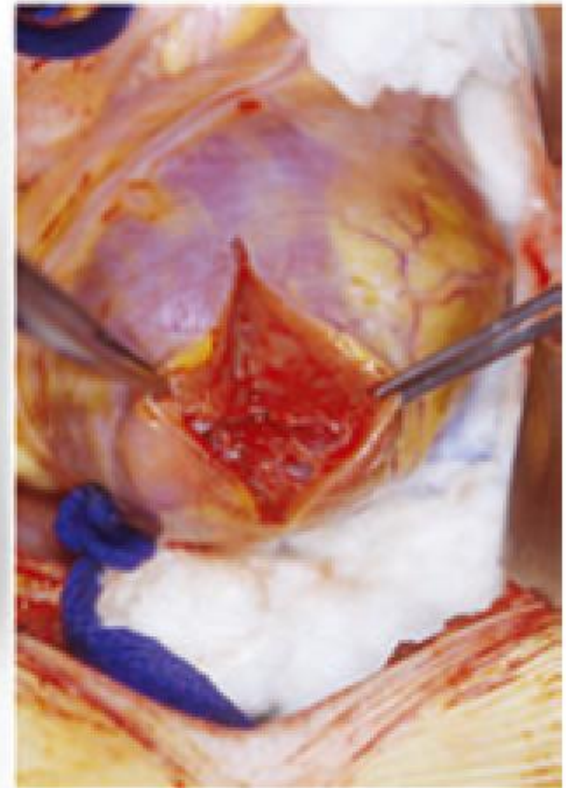
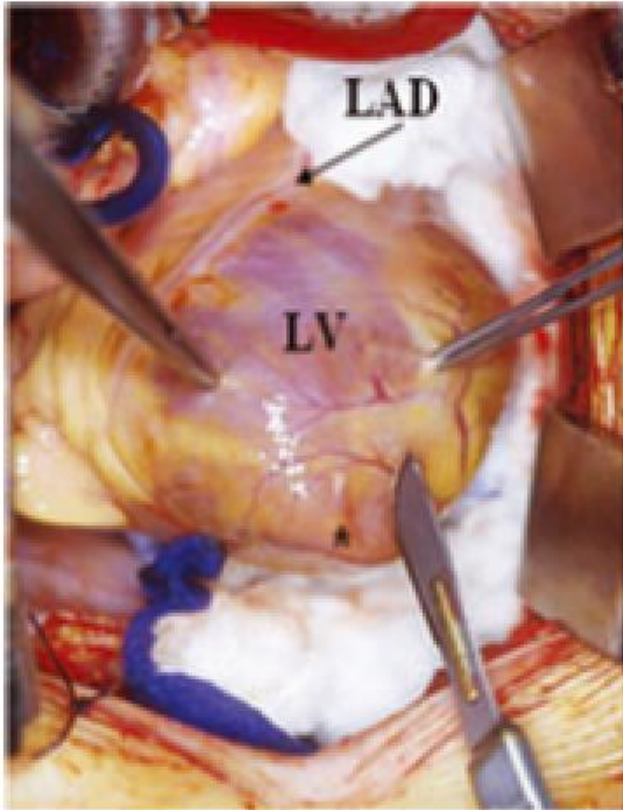
# HYPERTROPHIC CARDIOMYOPATHY: CLASSICAL MYECTOMY



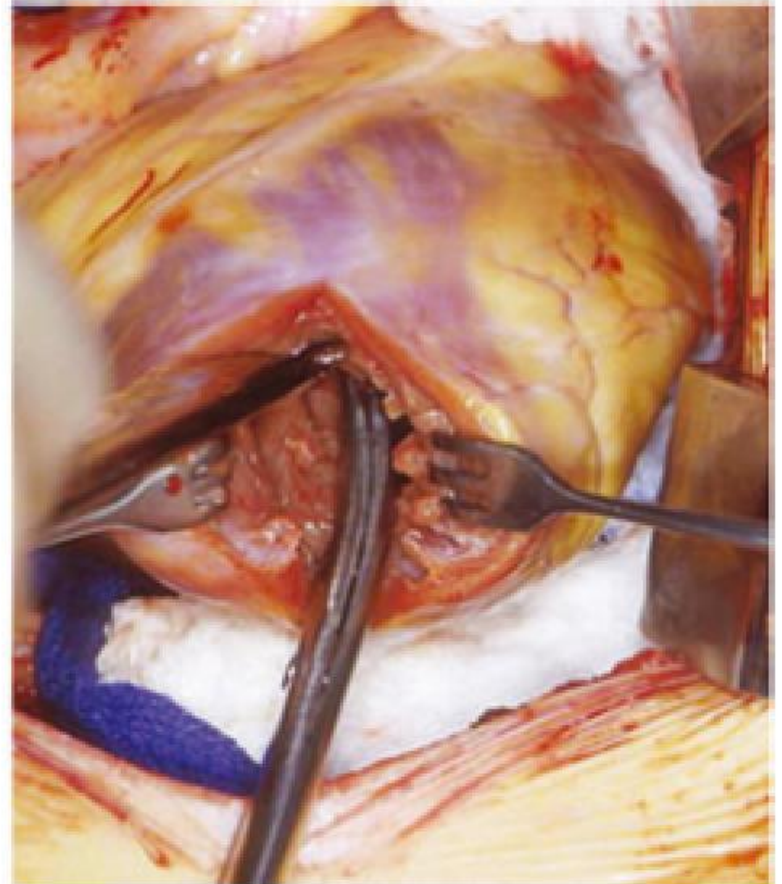
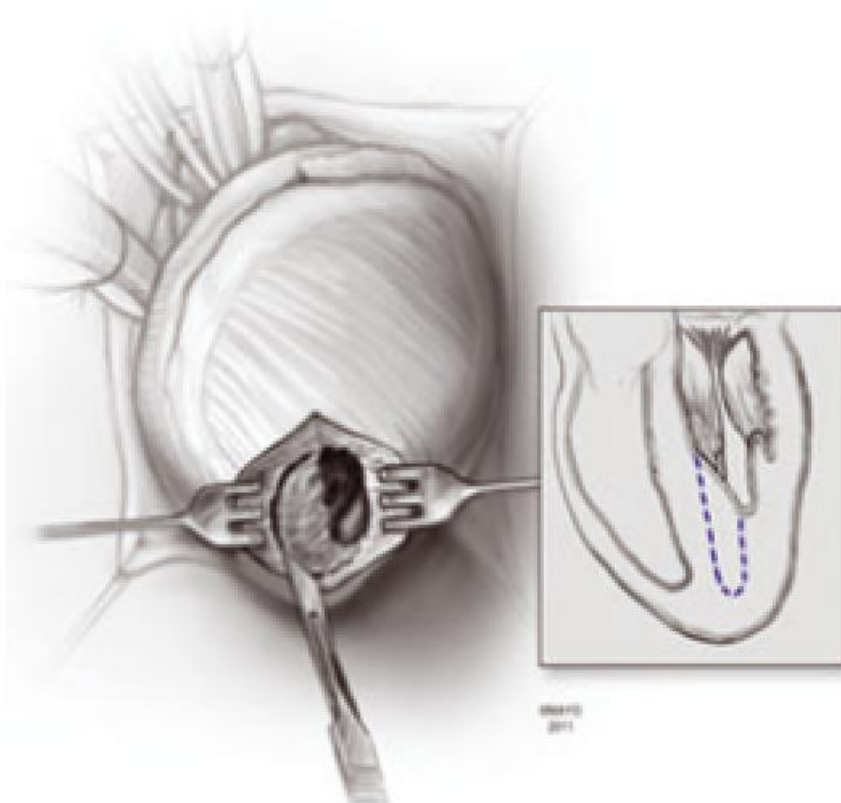
*Courtesy of Dr. J. Butany, Pathology Department, TGH*



# APICAL MYECTOMY



# APICAL MYECTOMY

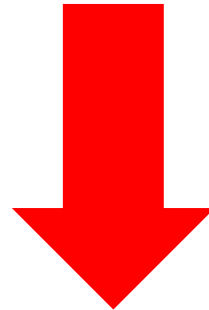




## CASE No 1: APPROACH TO PATIENTS' SYMPTOMS

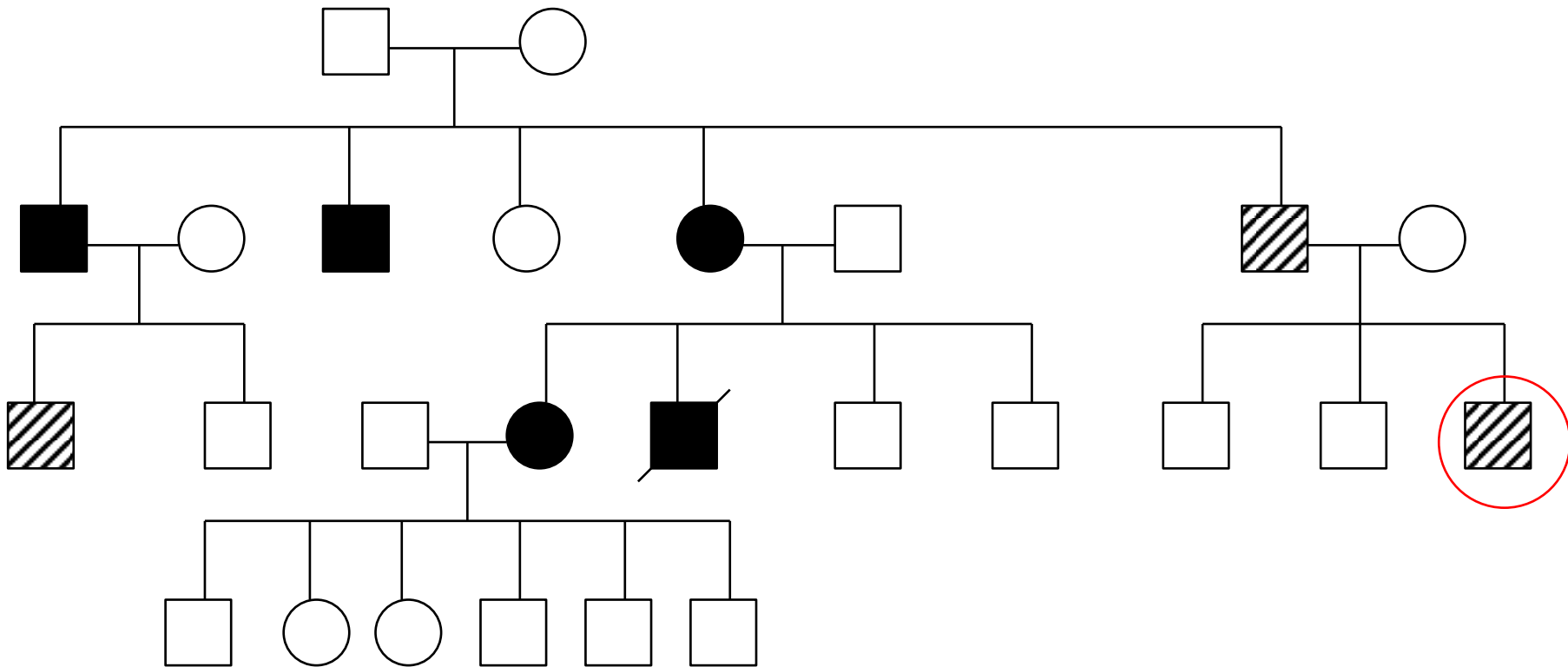
- Patient is in NYHA class II-III, currently under treatment with Verapamil 240mg, Bisoprolol 2.5mg and Torasemid 10mg
- Diastolic dysfunction, microvascular dysfunction, mild midventricular obstruction

### QUESTIONS TO THE EXPERTS



1. Trial with Ranolazine or Perhexiline despite absence of angina?
2. Apical myectomy?

## CASE No 2: FAMILIAL HCM, MYH7 c.428G>A p.R143Q

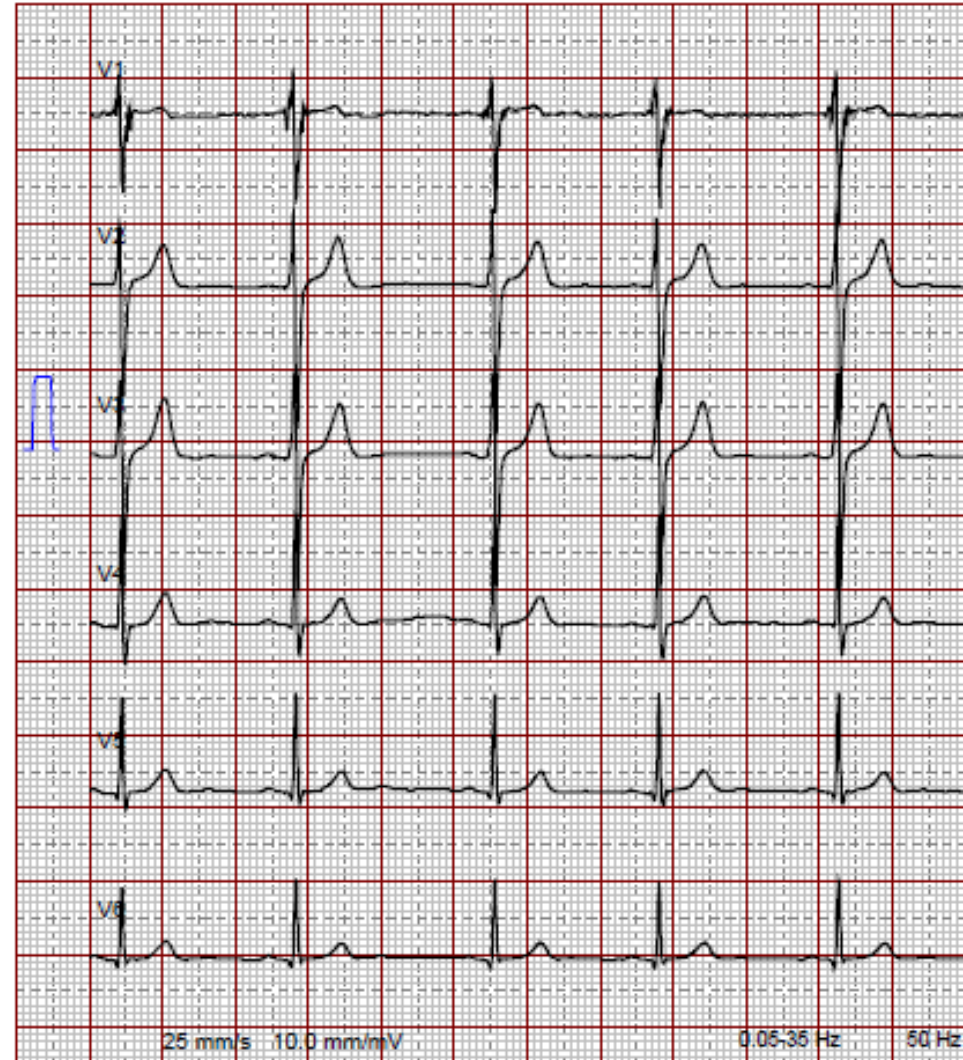
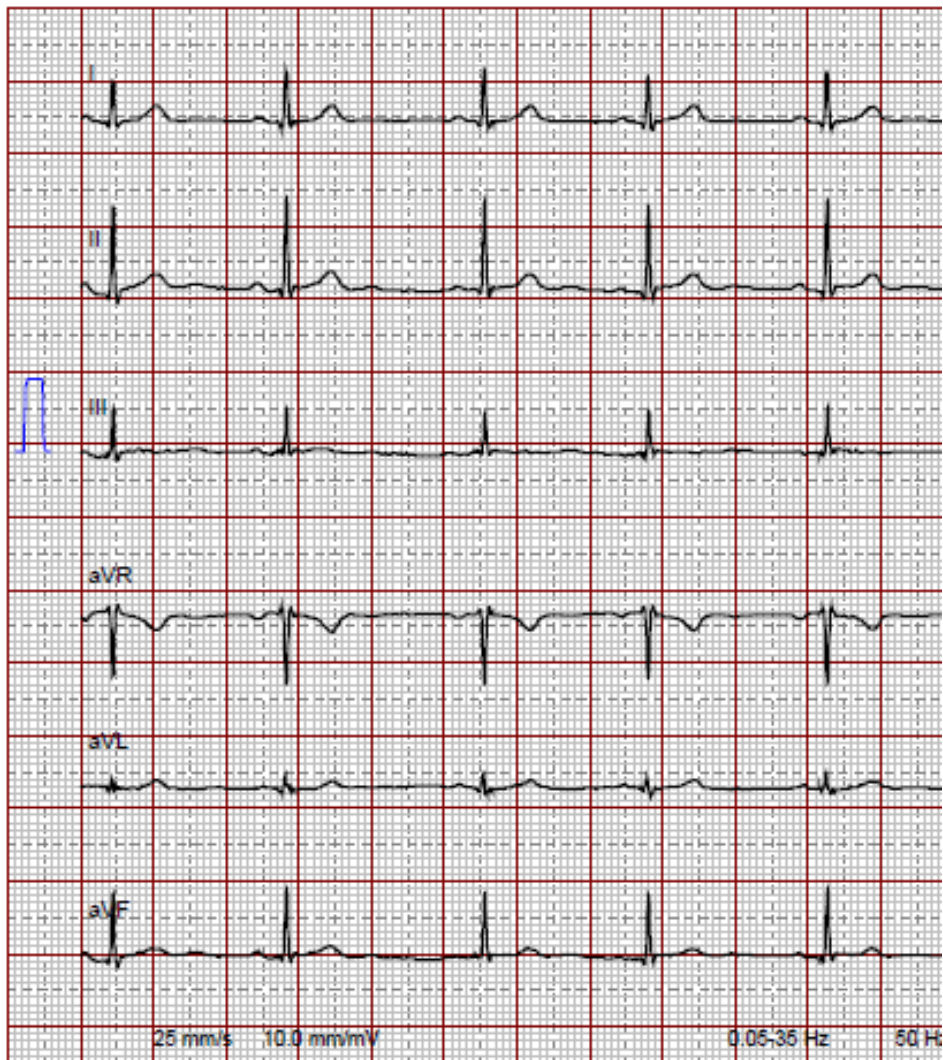


## CASE No 2: FAMILIAL HCM, MYH7 c.428G>A p.R143Q

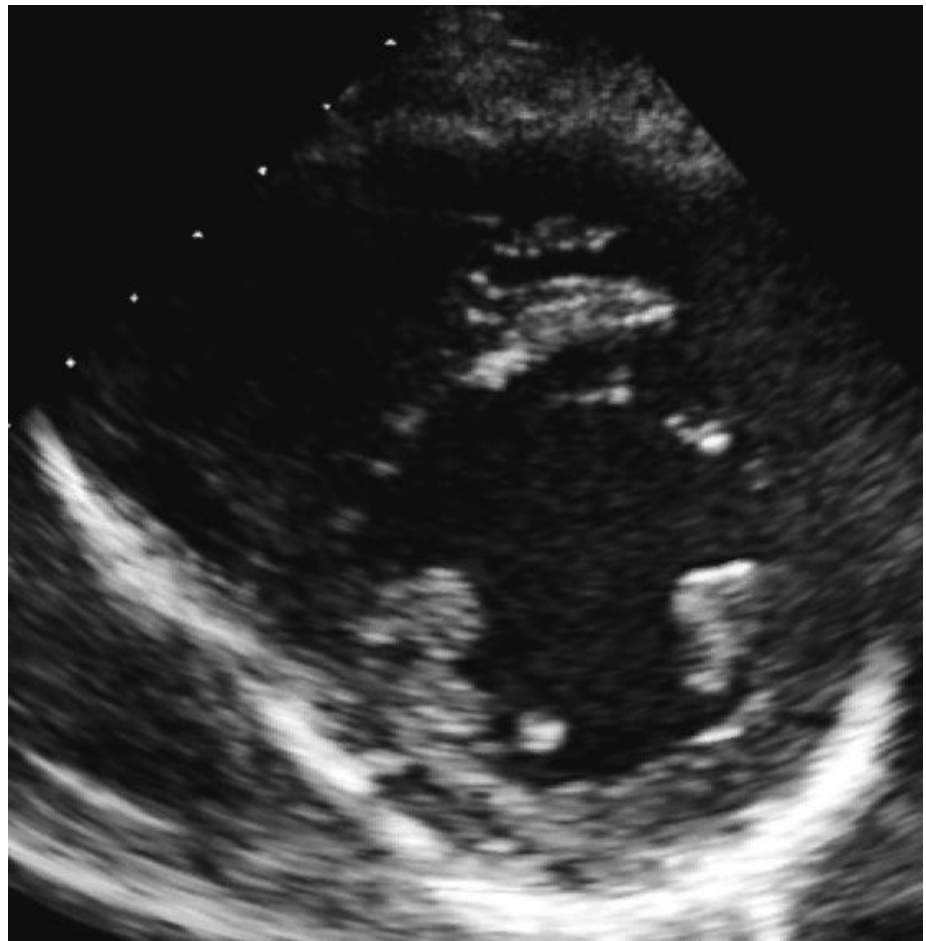
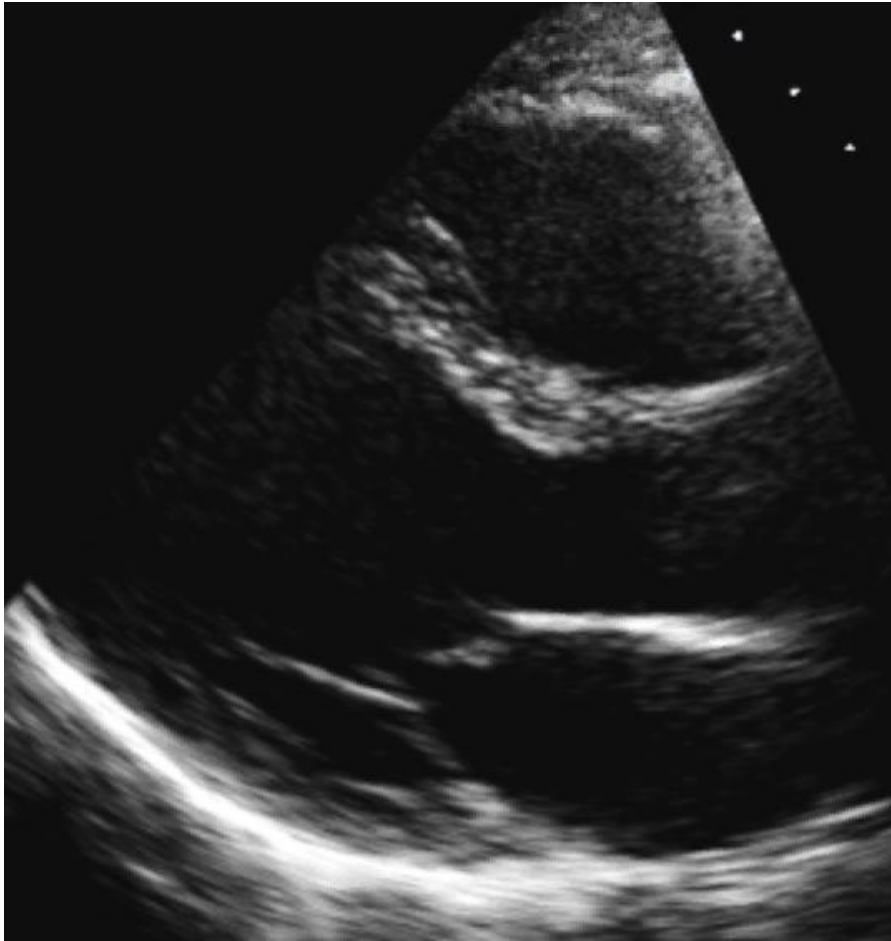
- 25 - year old male patient; family screening positive genotype and negative phenotype; genetic results known since February 2015
- syncope at the age of 20 and at the age of 24 (18 months ago)
- first syncope in 2009 during rock concert, alcohol intake, hot temperatures
- second syncope in fall 2013, nausea during dinner, went to the toilet and was urinating while standing, syncope; did not feel palpitations
- 48h Holter-ECG without nsVTs, not even a single VES

**neurocardiogenic syncope**

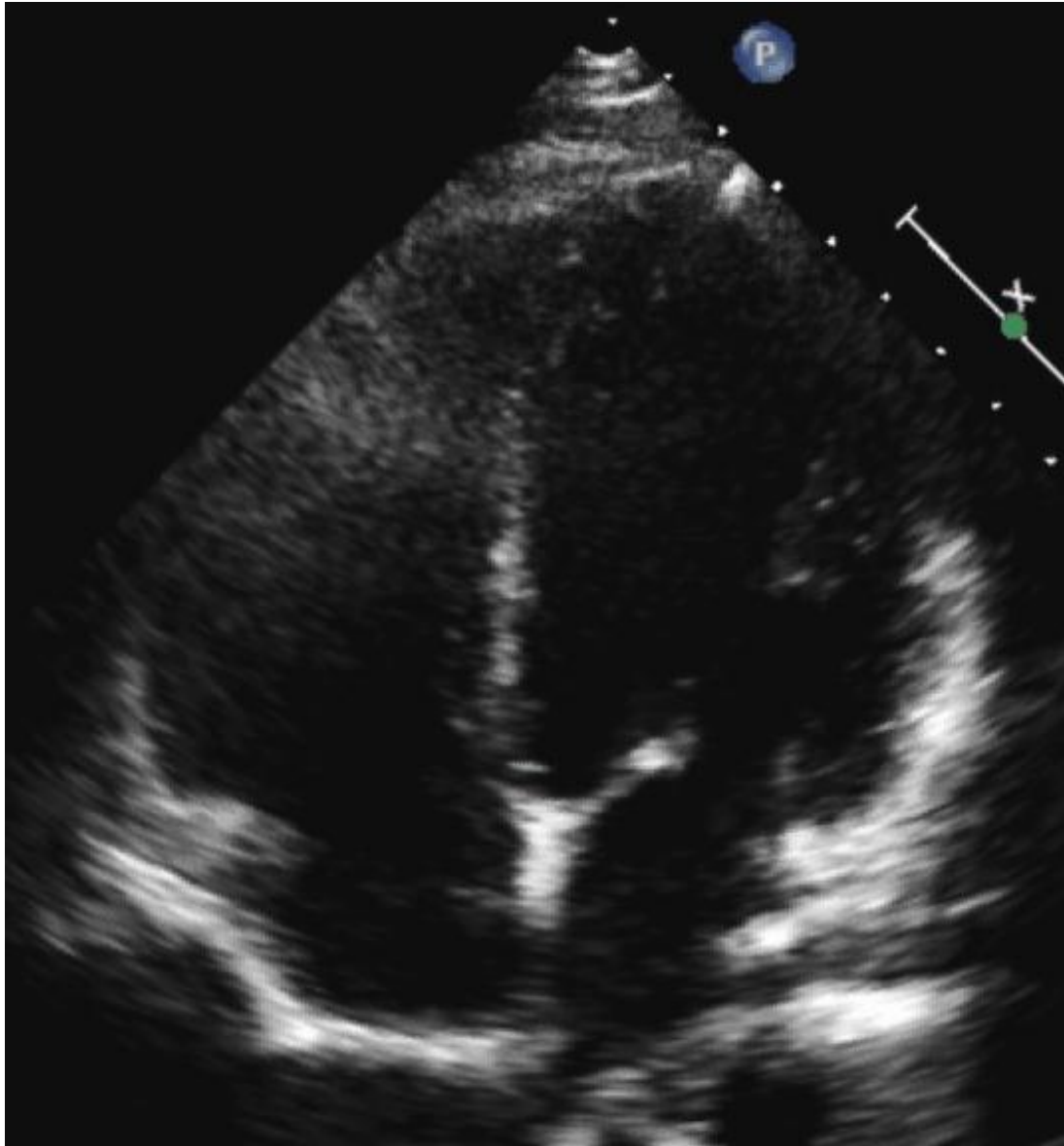
## CASE No 2: ECG



## CASE No 2: ECHOCARDIOGRAPHY



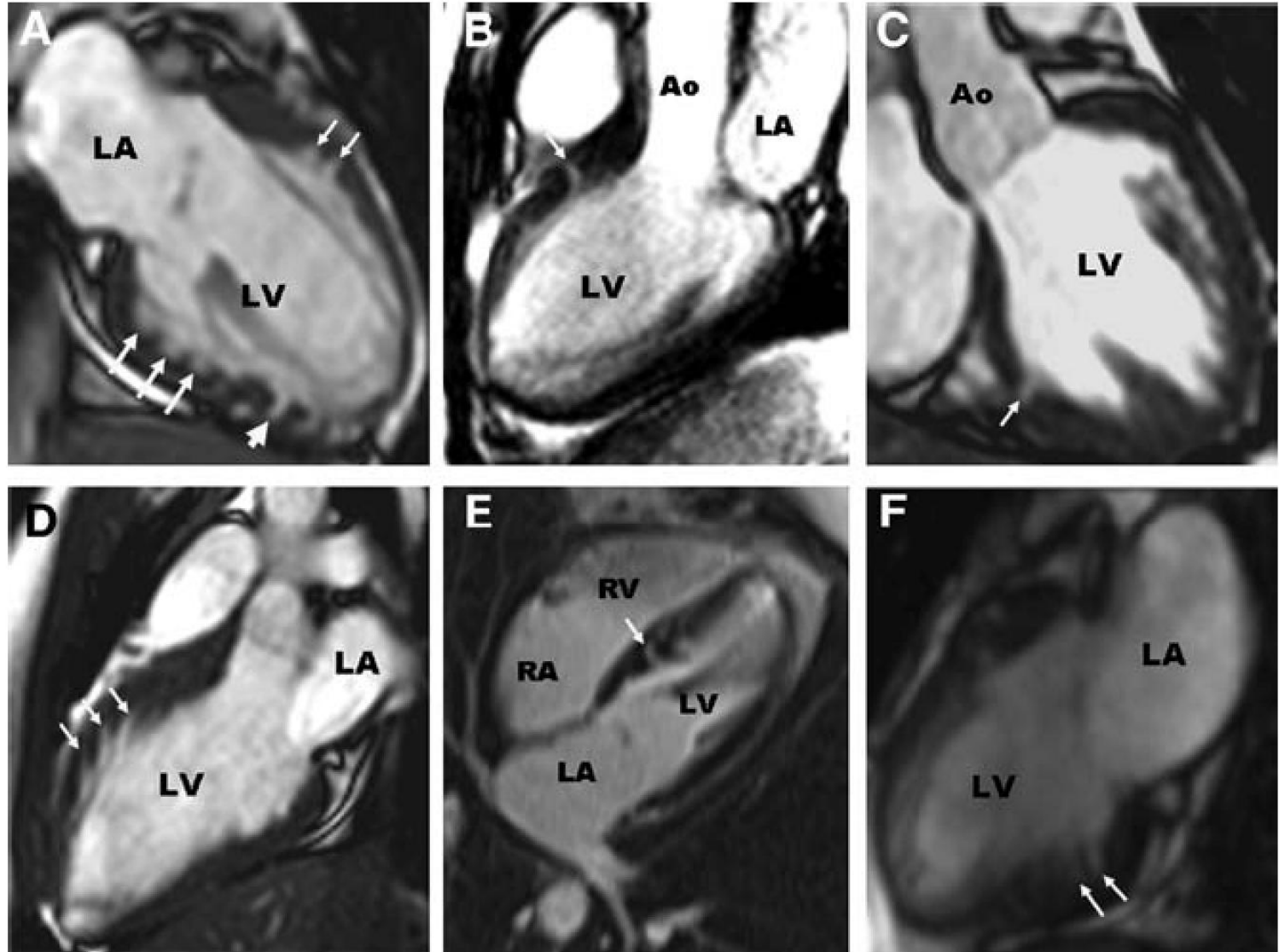
## CASE No 2: ECHOCARDIOGRAPHY





# SUBTLE MORPHOLOGICAL ABNORMALITIES IN G+/P\* HCM

## MYOCARDIAL CRYPTS/CLEFTS



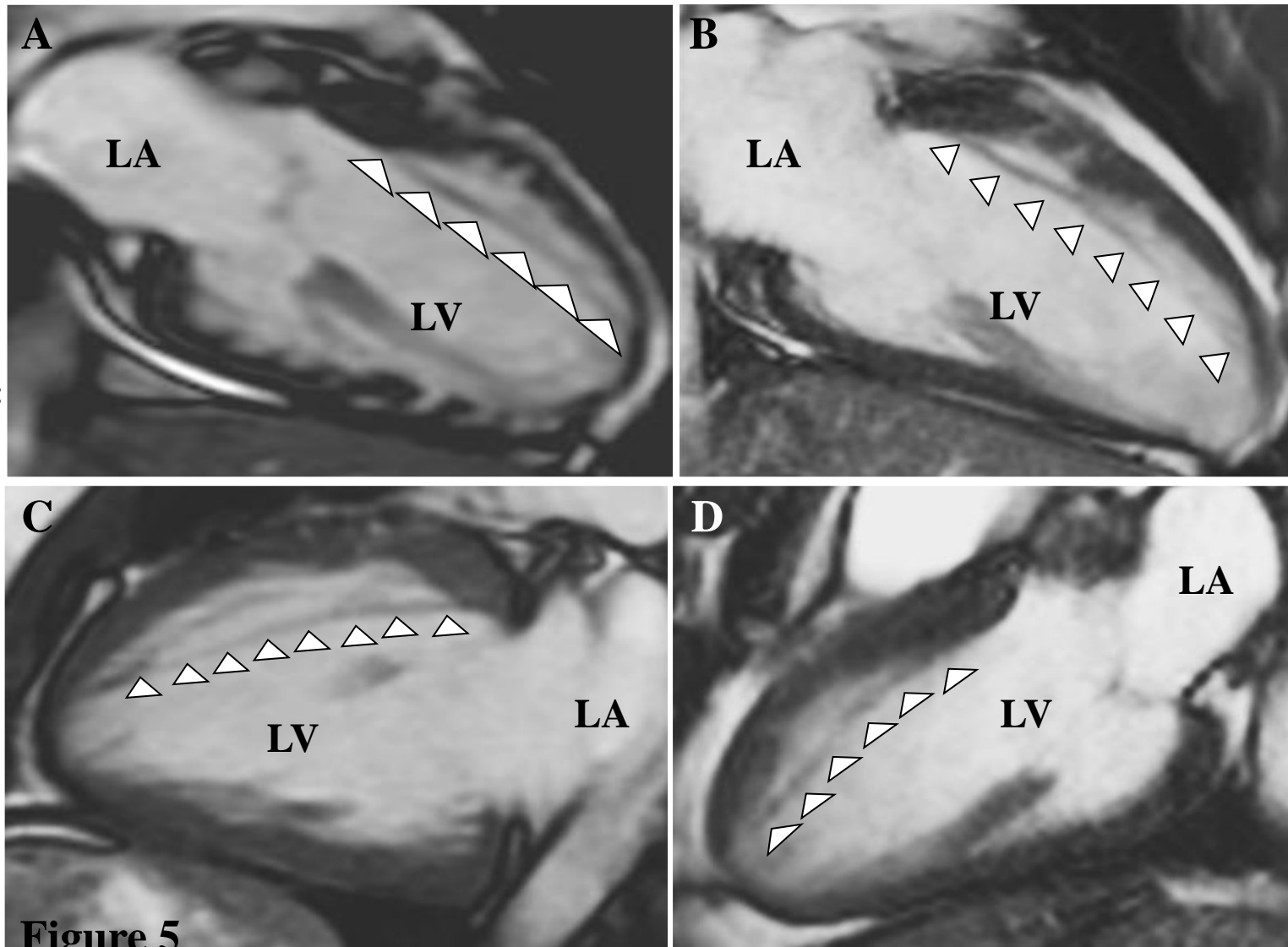
G+/P- 61%  
HCM + LVH 4%  
Controls 0%



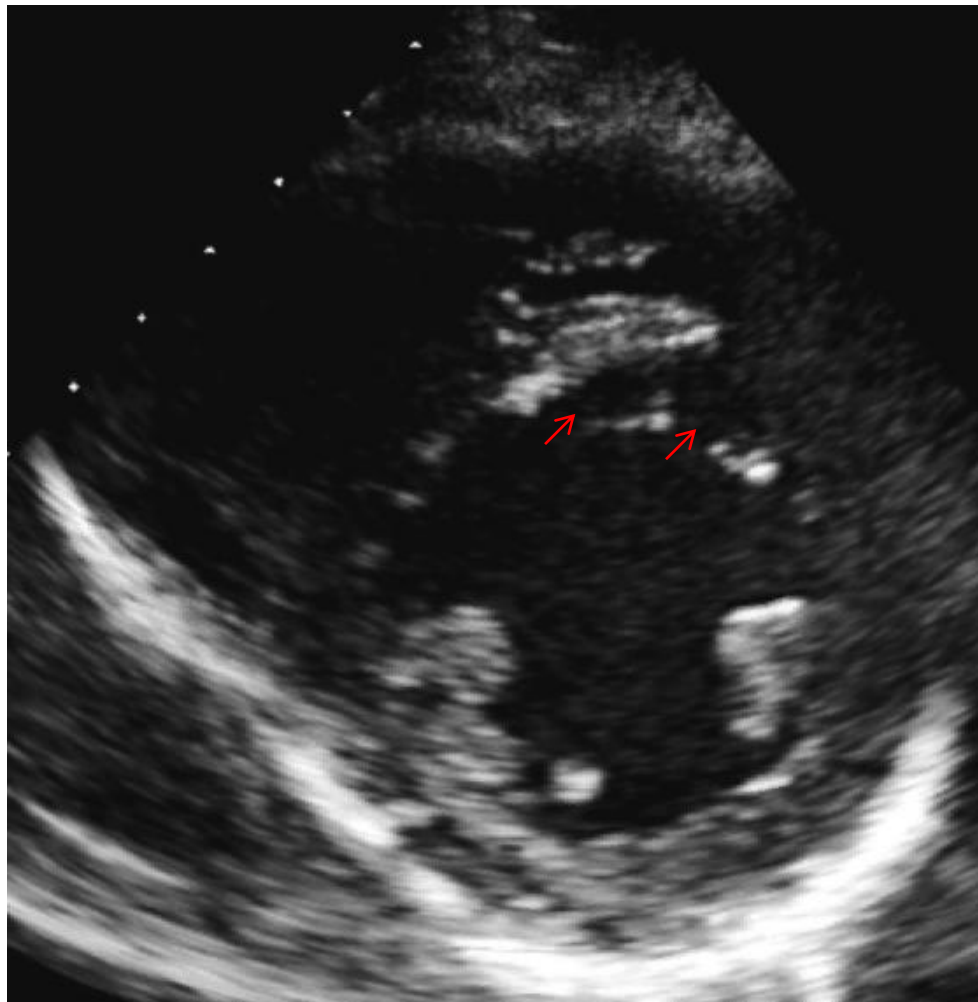
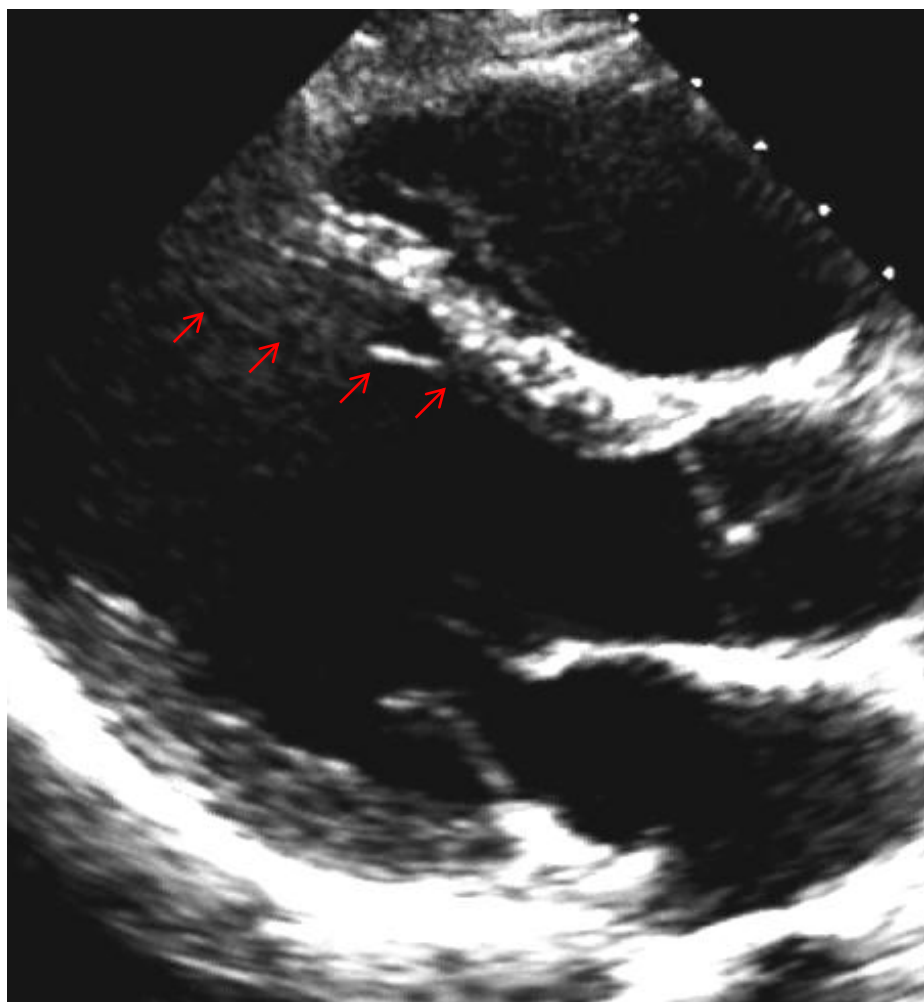
# SUBTLE MORPHOLOGICAL ABNORMALITIES IN G+/P\* HCM

## APICAL-BASAL MUSCLE BUNDLE

G+/P- 60%  
HCM + LVH 63%  
Controls 10%



## CASE No 2: ECHOCARDIOGRAPHY



## CASE No 2: SUMMARY

1. G+/P- subject with subtle morphological signs (LV apical-basal muscle bundle, bifide papillary muscles); should prompt genetic testing
2. Syncopes most likely neurocardiogenic
3. CMR is planned

## CASE No 2: QUESTION TO THE EXPERTS

1. What is the approach for risk stratification for SCD in G+/P- HCM subjects?
2. Should a reveal be considered?