# EFFECT OF HYPERTROPHY AND FIBROSIS ON REGIONAL FUNCTIONAL HETEROGENEITY IN HYPERTROPHIC CARDIOMYOPATHY

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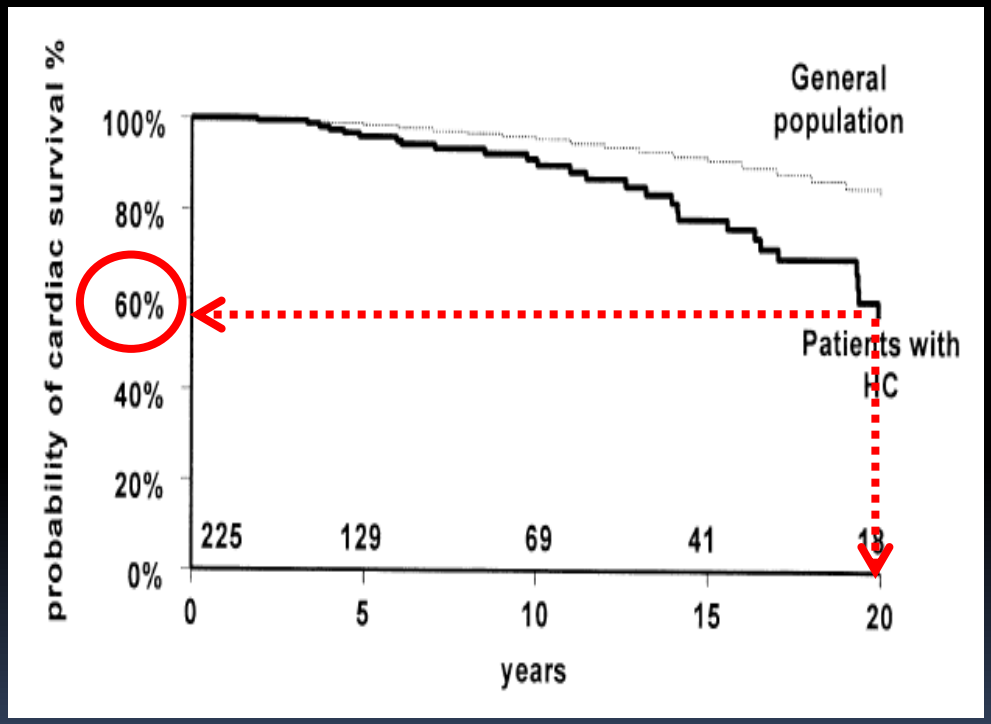
# Hypertrophic Cardiomyopathy

- Heterogeous hypertrophy of myocardium
- Genetic abnormality in HCMP patients is common
- Global pathology of muscular disarray and hypertrophy

**→ HCMP is not a regional disease, but disease involving whole myocardium**

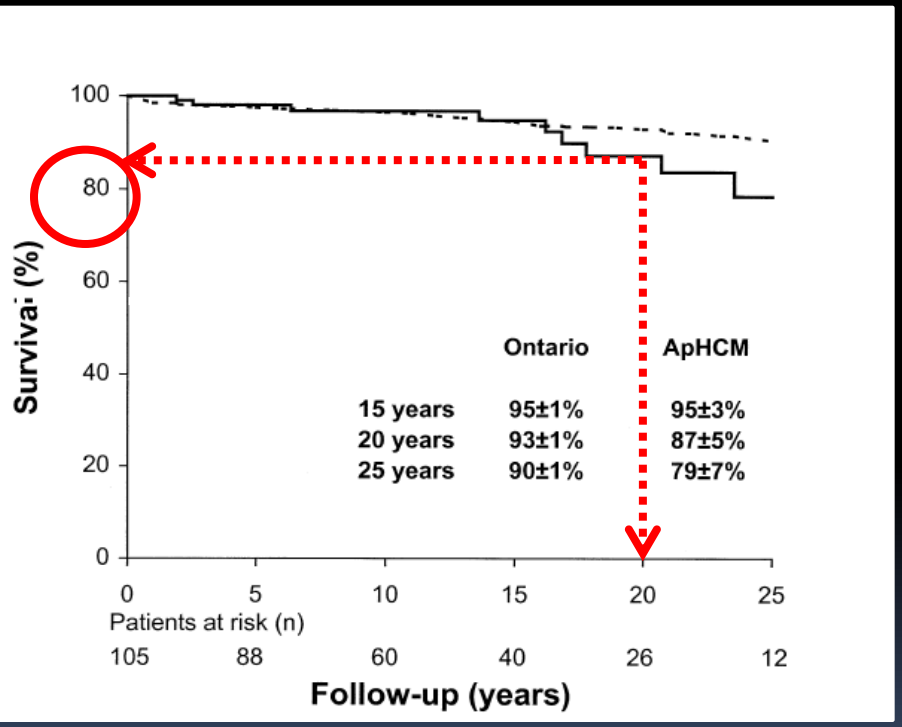
# Clinical Prognosis in Different Type of HCM

## Septal HCMP




Kofflard MJM et al. JACC 2003;41:987-93

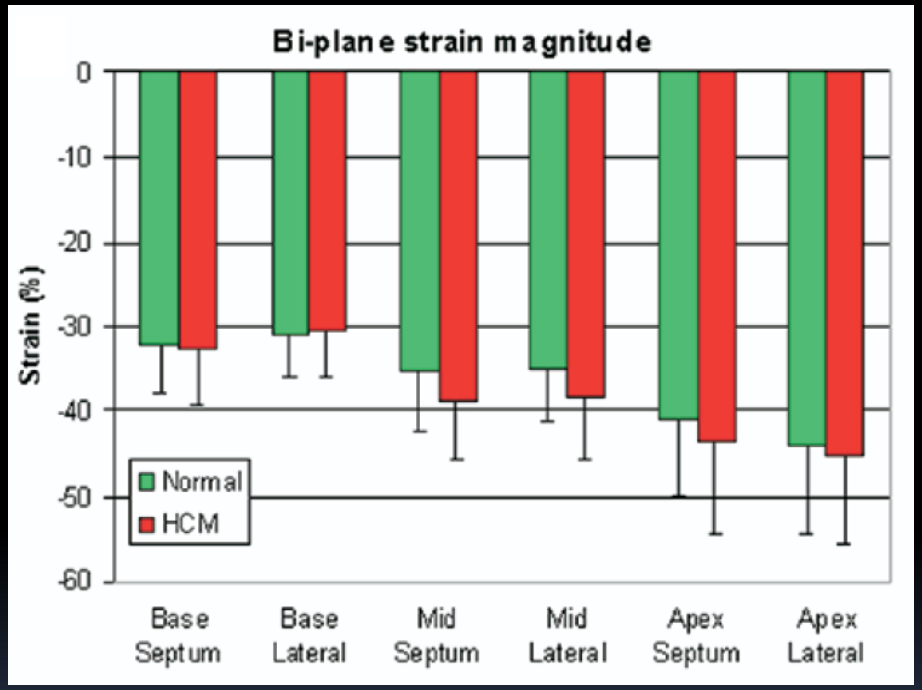
## Apical HCMP




Eriksson MJ et al. JACC 2002;39:638-45

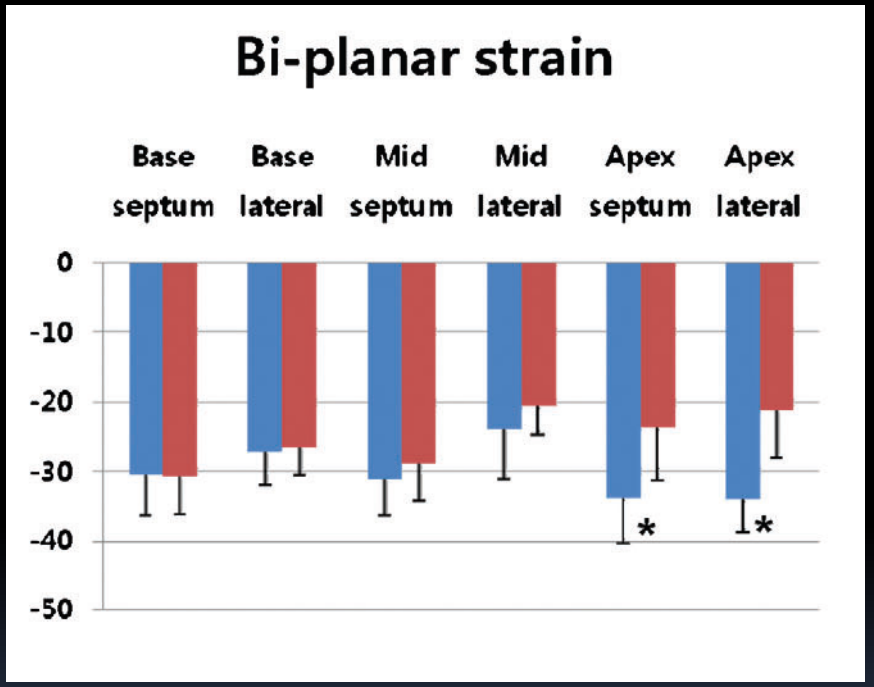
# Functional Difference in Different Type of HCM

## Septal HCMP



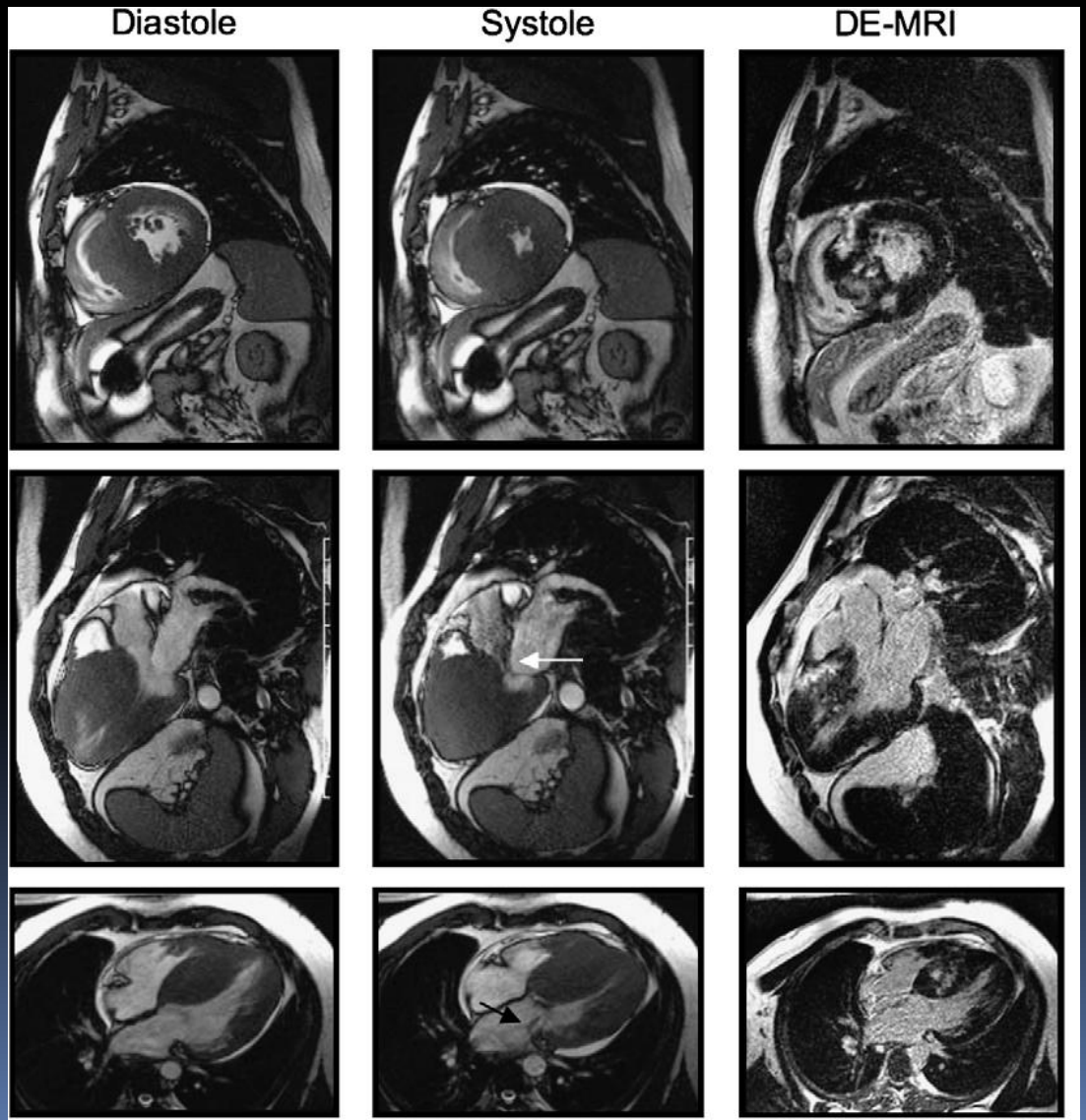

Carasso S et al. JASE 2008;675-81

## Apical HCMP



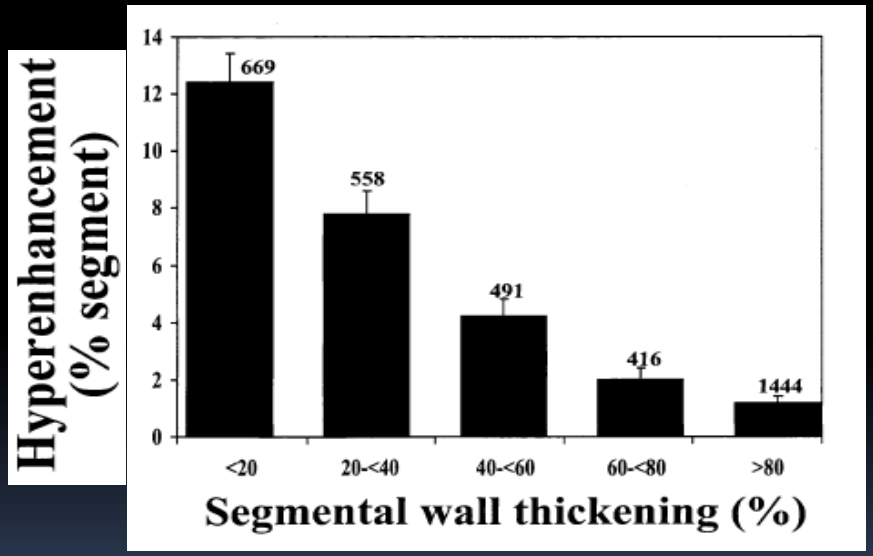

Chang SA et al. Heart 2010;96:49-55

# Myocardial Fibrosis : DHE in HCMP



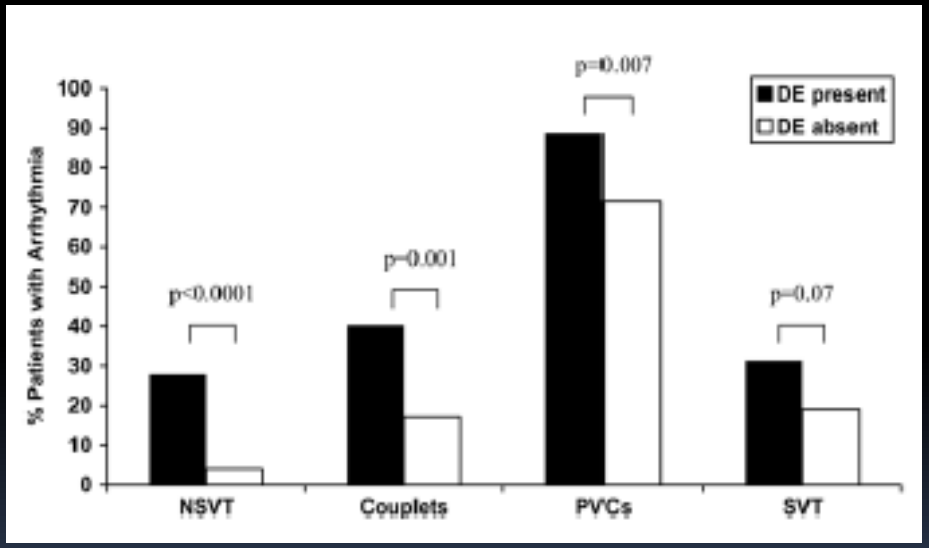
# Significance of DHE in HCM

## Myocardial wall scarring and contractility in HCM




Choudhury, JACC 2002

## Prevalence of arrhythmias on Holter with respect to DHE in HCM




Adabag, JACC 2008

# Aim of Study

-Effect of hypertrophy and fibrosis on regional functional heterogeneity in HCMP

- Effect of regional heterogeneity on global function of LV in HCMP

# METHOD

# Study Population

## Inclusion Criteria

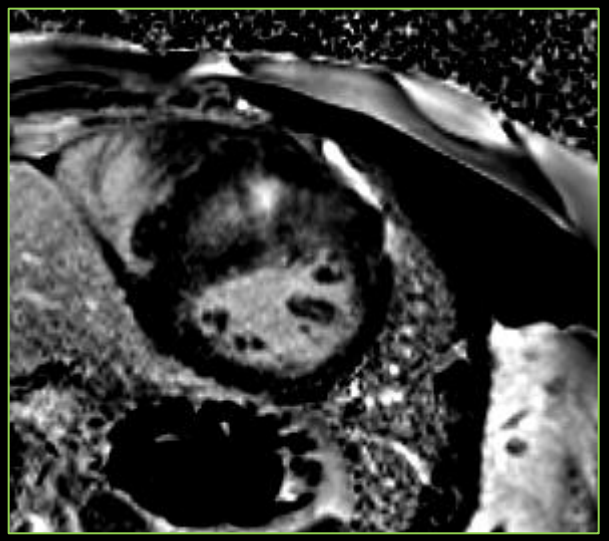
- Confirmative Diagnosis in Cardiac MRI
- Cardiac MRI with delayed enhanced image

## Exclusion Criteria

- Arrhythmia including atrial fibrillation
- Significant valvular disease (more than grade 3)
- Poor echoCG window for strain analysis

# Cardiac MRI

Siemens 1.5T MRI (AVANTO)



Cine MRI
- 6mm thickness with 2mm gap
- Short axis/Long axis of whole LV

Delayed hyper-enhanced MRI (DHE-MRI)
- Galdolinium contrast agent
- Image acquisition 10 minute after contrast injection
- Segmental analysis (18segments) of DHE with semi-quantitative manner

# Echocardiogrphy

- Vivid 7 machine (GE)

- Blood pressure, BSA measurement : before echoCG
- Routine EchoCG including

• LVEDD/ESD/EF, mitral inflow, tissue Doppler in mitral septal annulus

LA volume

- Image acquisition for speckle tracking

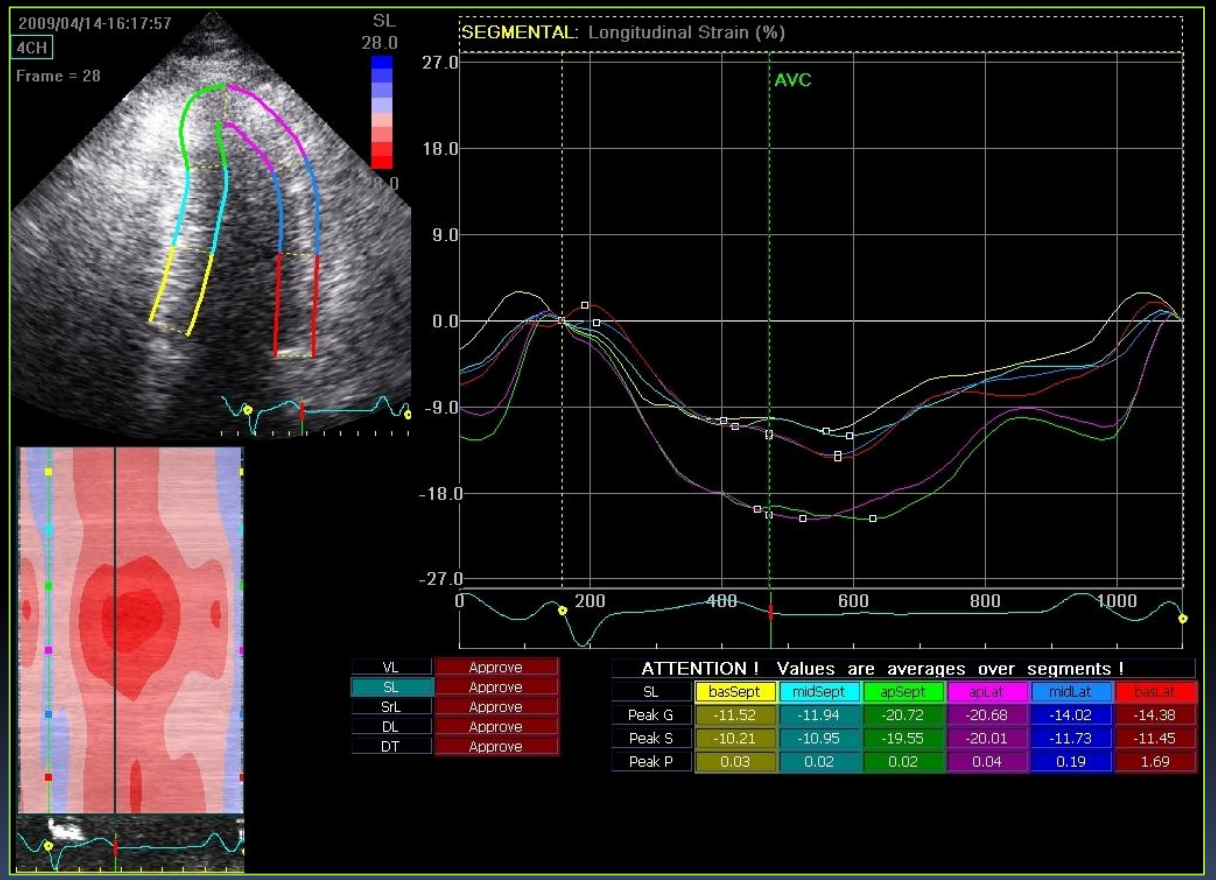
• Apical 2/3/4 chamber view

• *Frame rate* (70~100 fps) and probe frequency of 1.7~2.0 MHz were adjusted during end-expiratory breath-hold

# Image Analysis

- Off- line analysis by single researcher
- Echopac PC ver 7.05, GE Medical system
- Manual tracing of endocardial border in end systolic frame → confirm successful tracking score and visually tolerable tracking image
- Regional longitudinal strain was derived (18 segments model)

# Longitudinal Strain by 2D Speckle Tracking Image



# RESULT

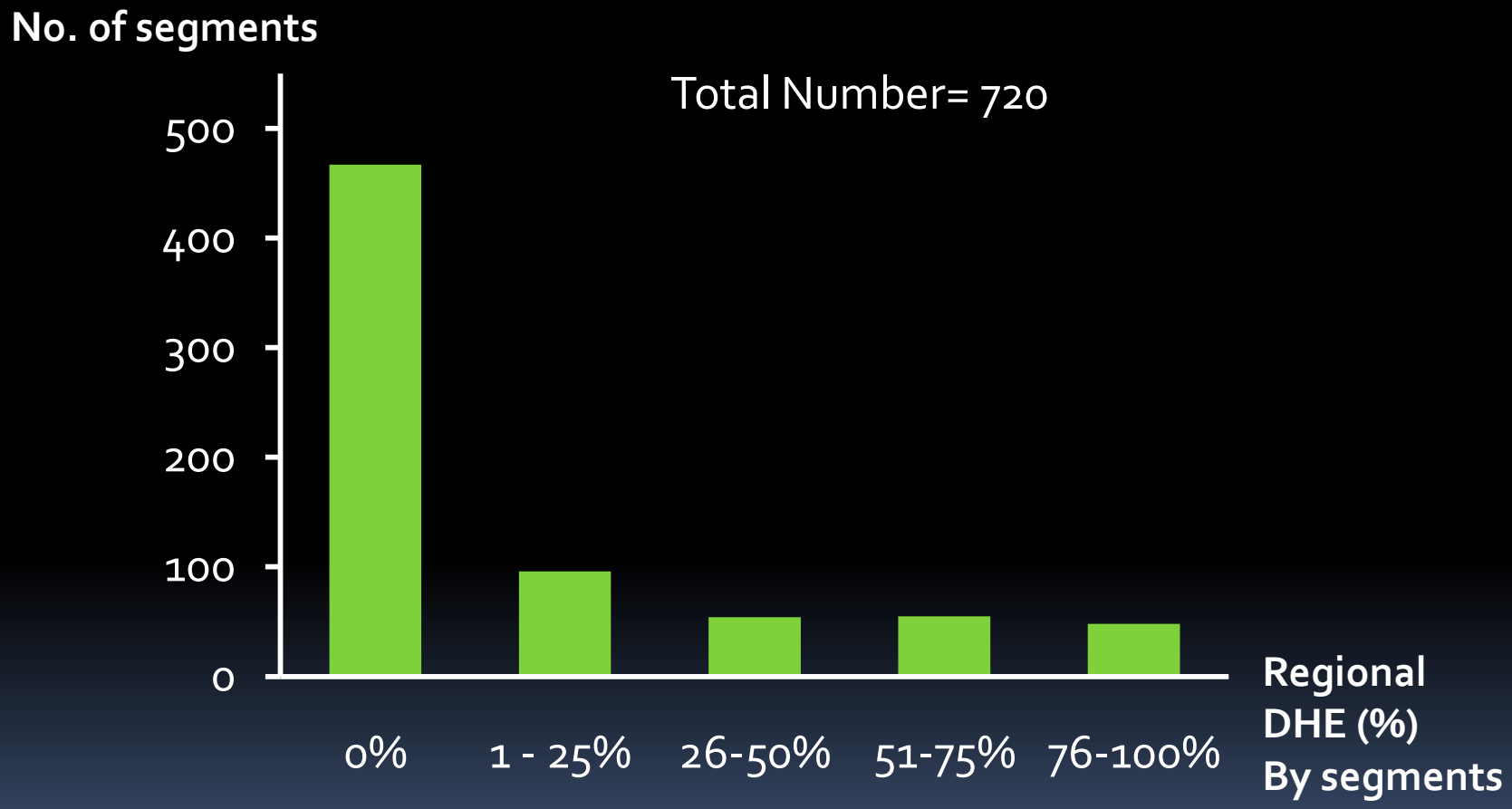
# Characteristics of Patients

| | N=40 |
|---|---|
| Age | 52.7 ± 12.2 |
| Male | 31 (77.5%) |
| Type of HCM | |
| Septal | 15 (37.5%) |
| Apical | 13 (32.5%) |
| Septal + Apical | 5 (12.5%) |
| Diffuse | 4 (10.0%) |
| Others | 3 (7.5%) |

# MRI parameters

| | N=40 |
|---|---|
| LV ESV (ml) | 41.1 ± 24.1 |
| LV EDV (ml) | 138.3 ± 34.5 |
| LV EF (%) | 71.3 ± 11.0 |
| LV mass (g) | 148.9 ± 62.1 |
| LV mass index ($g/m^2$) | 81.7 ± 30.7 |
| Presence of DHE in LV | 31 (78%) |
| DHE (%) | 19.41% |

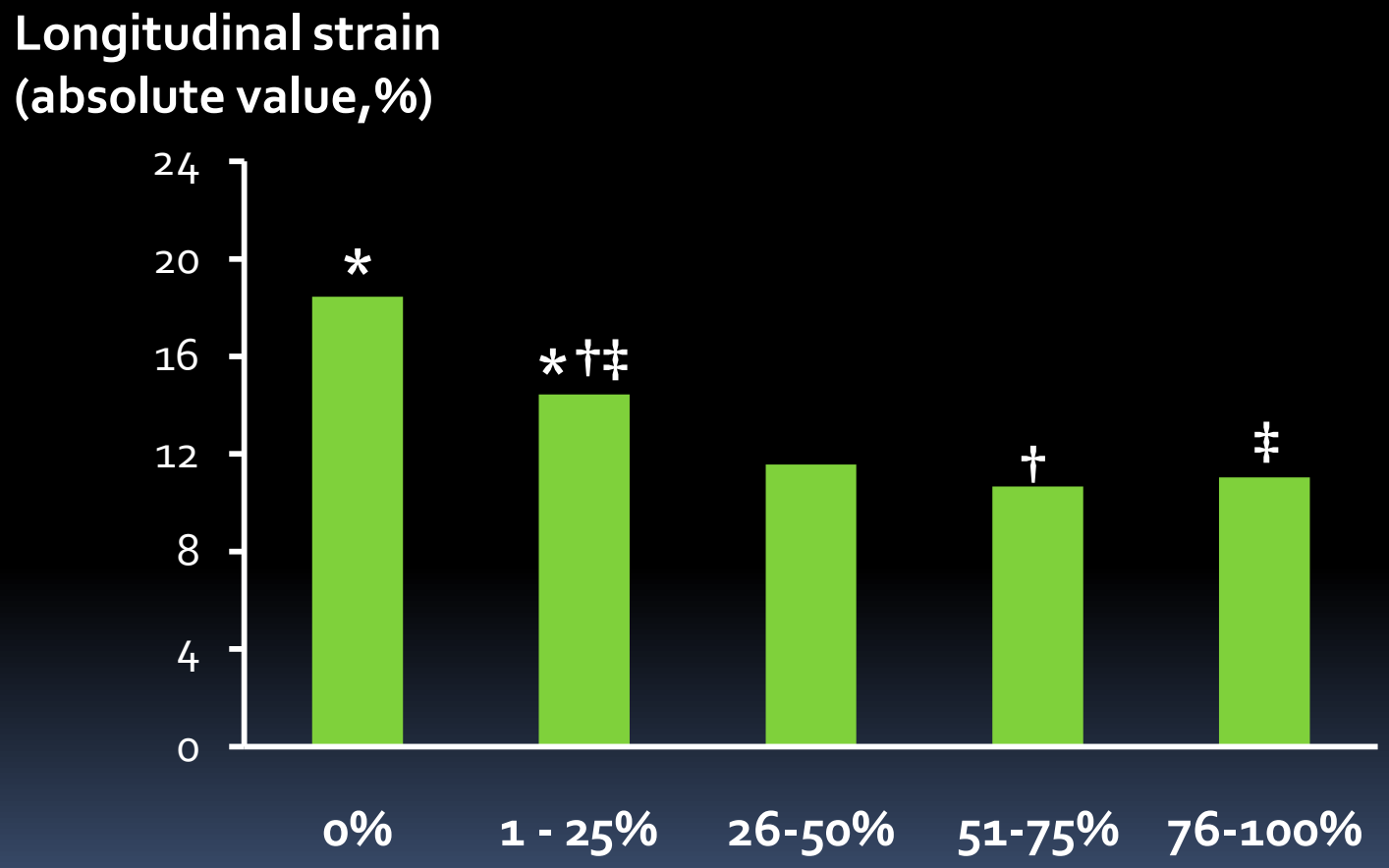
# DHE in Regional Myocardial Segments



# Echocardiographic parameters

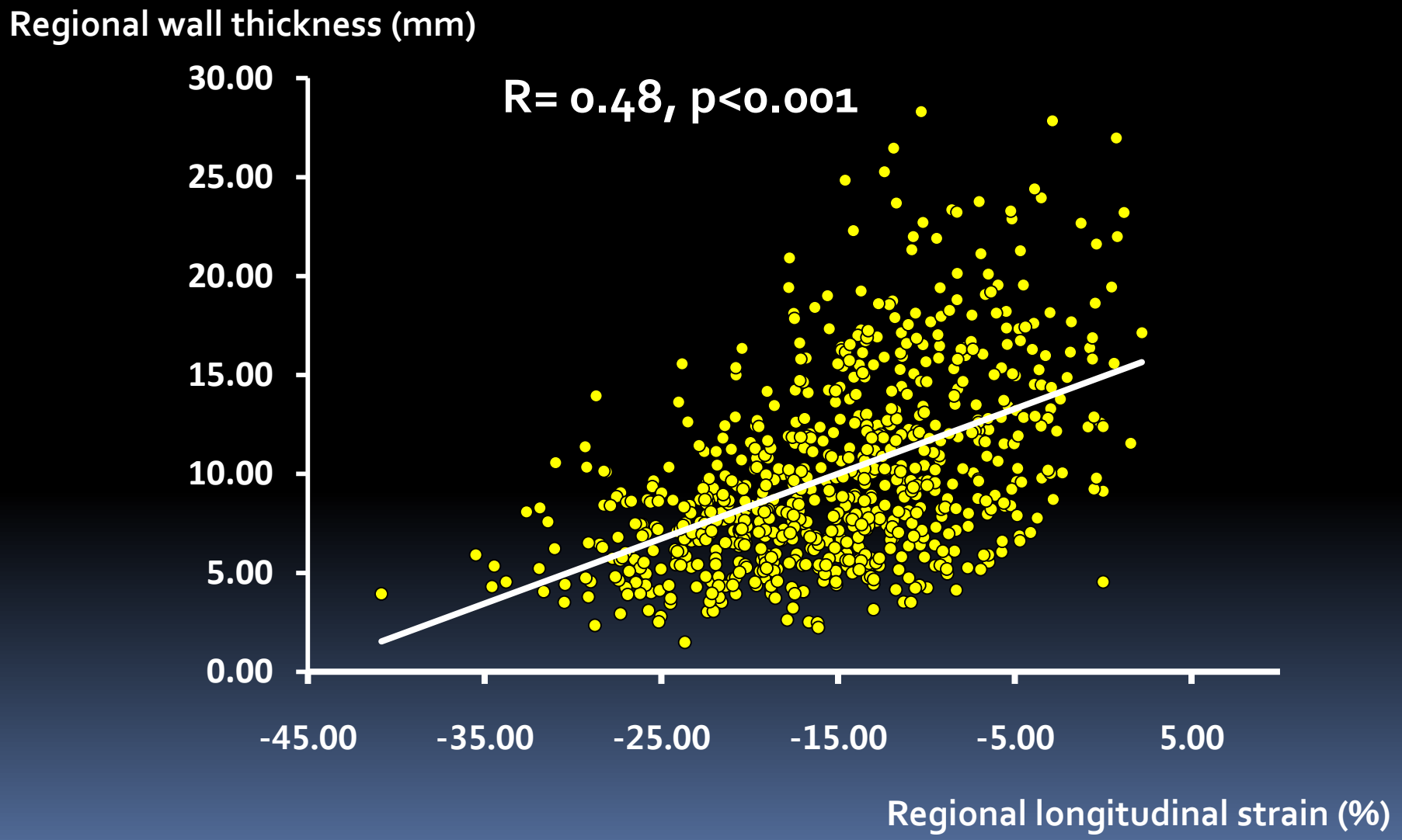
| | N=40 |
|---|---|
| Presence of LVOT obstruction | 9 ( 23%) |
| E (m/s) | 0.67± 0.17 |
| A (m/s) | 0.63 ± 0.21 |
| DT (msec) | 244.1±84.5 |
| E’ (cm/sec) | 6.0 ± 2.2 |
| A’ (cm/sec) | 9.8 ± 10.1 |
| E/E’ | 12.0 ± 3.5 |
| LA volume index (ml/$m^2$) | 40.5 ± 18.5 |

# Regional wall DHE and Regional Strain

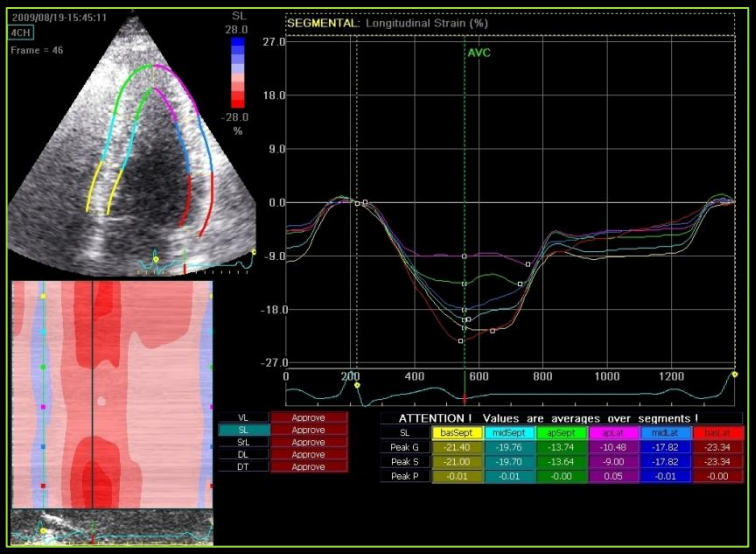


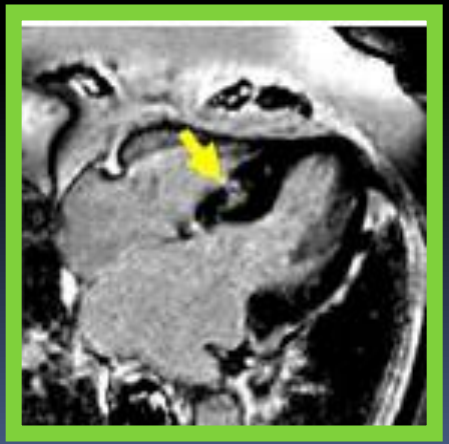

*P<0.001, †P<0.01, ‡P<0.05

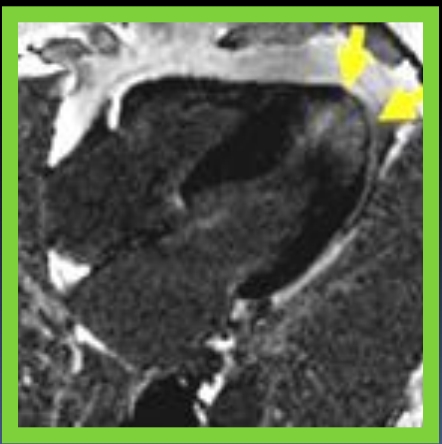
# Regional wall thickness and Regional Strain



# DHE, Hypertrophy, and Strain

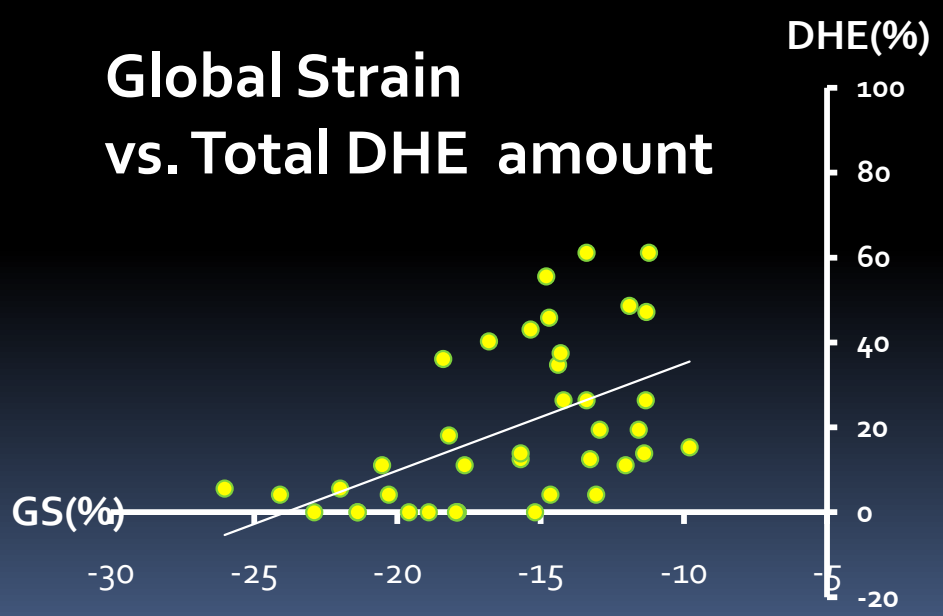



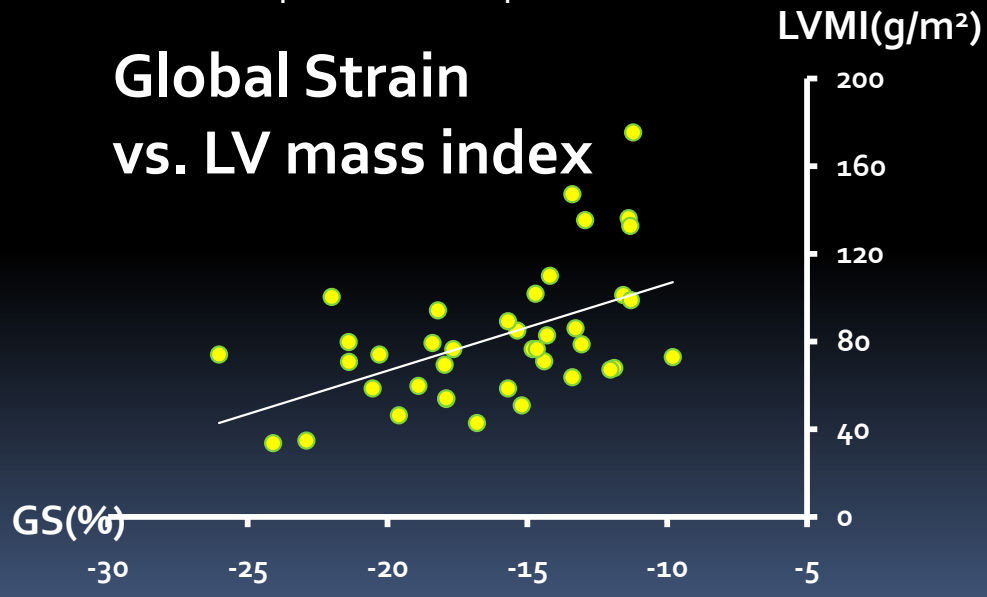


# Global longitudinal strain, LV mass, and DHE

| Parameters | r | P value |
|---|---|---|
| Total DHE amount (%)* | 0.50 | <0.001 |
| LV mass index (g/m²)* | 0.49 | 0.001 |

* nonparametric Spearman correlation



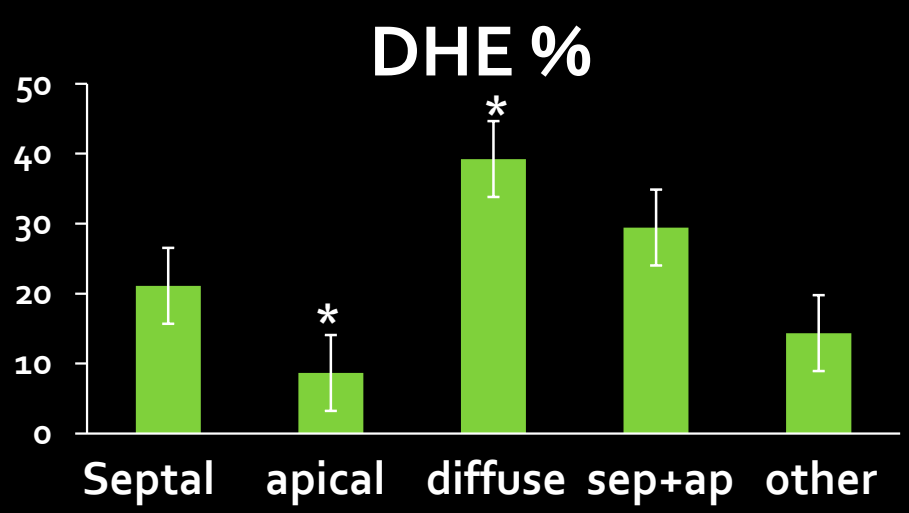



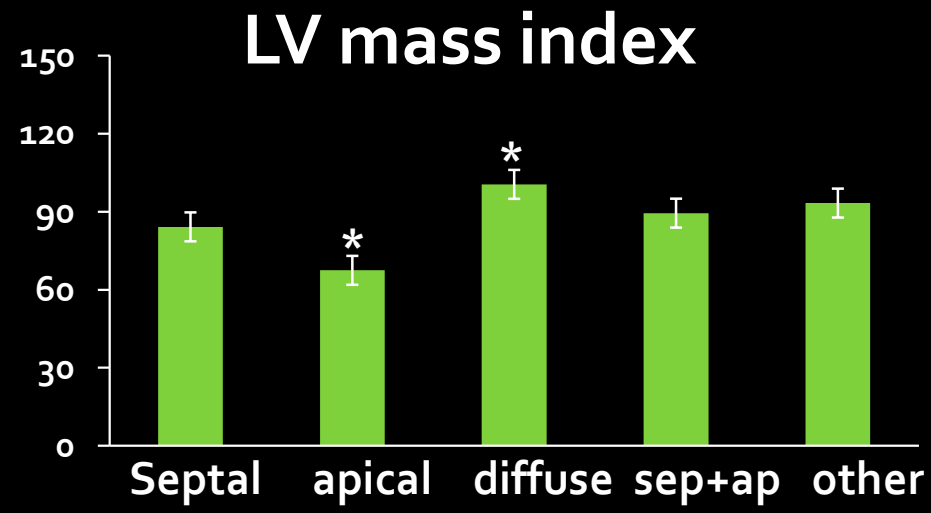
# Global longitudinal strain and LV function

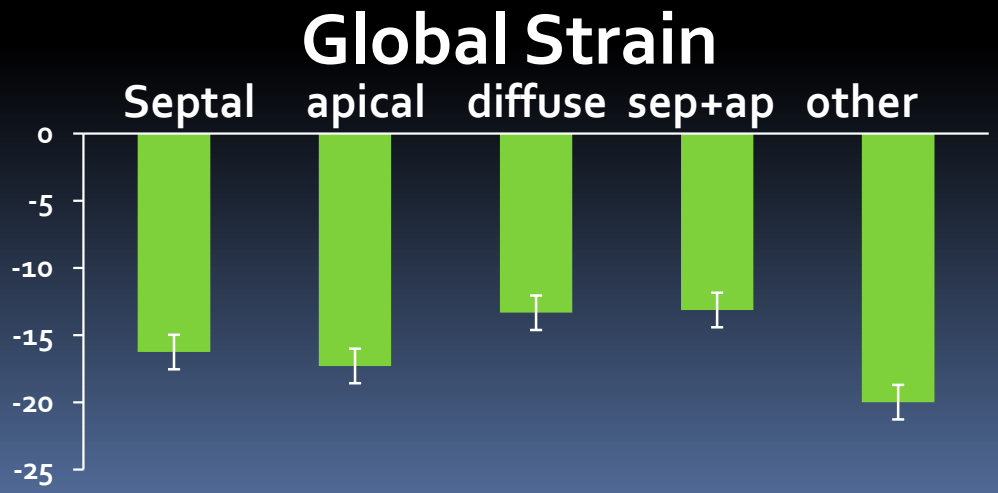
| Parameters | r | P value |
|---|---|---|
| E (m/s) | -0.36 | 0.02 |
| A (m/s) | 0.41 | 0.01 |
| DT (msec) | 0.05 | 0.77 |
| E' (cm/sec)* | -0.53 | <0.001 |
| A' (cm/sec) * | -0.13 | 0.44 |
| E/E'* | 0.33 | 0.04 |
| LA volume index (ml/m$^2$) | 0.35 | 0.03 |
| LV EF (%, MRI) | 0.01 | 0.98 |

* nonparametric Spearman correlation

# Global longitudinal strain, LV mass, and DHE




* P <0.05

# SUMMARY

- Presence and degree of DHE represents more severe functional impairment of regional myocardium
- Amount of DHE is related with increased wall thickness of regional myocardium
- Global longitudinal strain is correlated with total amount of DHE, LV mass index , and diastolic functional parameters.

# CONCLUSION

- HCMP is a global myocardial disease, however morphologic heterogeneity of HCMP is associated with regional heterogeneity of myocardial function.

- Different severity of fibrosis and hypertrophy in regional walls is associated with functional impairment. It might explain the different myocardial mechanics and clinical prognosis in different type of HCMP.

# Thank You for Your Attention