

Advanced Echocardiographic analysis in Hypertensive patients

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Introduction

Hypertension is a major and correctable **cardiovascular risk factor**. The correct diagnosis of hypertension and precise assessment of cardiovascular risk are essential to give proper treatment in patients with hypertension.

Echocardiography gives many clues suggesting bad prognosis associated with hypertension, including **increased left ventricular (LV) mass, decreased LV systolic function, impaired LV diastolic function, and increased left atrial size and decreased function**.

Recommendations of echocardiography in the current hypertension guidelines

In the **2013 ESH/ESC Guidelines** for the management of arterial hypertension recommended performing echocardiographic examination in patients who are suspected with having **left ventricular hypertrophy (LVH), left atrial (LA) dilatation, or concomitant heart diseases.**

What are the clinical situations when the echocardiography is recommended in the evaluation and treatment of arterial hypertension??

Clinical situations when the echocardiography is recommended in the evaluation and treatment of arterial hypertension

Clinical situations

Heart failure is suspected

Signs

-Symptoms: exertional dyspnea, orthopnea, generalized edema, etc.

-Abnormal physical examination: cardiac murmurs, pretibial pitting edema, etc.

-Abnormal ECG results: left ventricular hypertrophy, left atrial enlargement, left bundle branch block, pathologic Q waves, poor R progression, atrial fibrillation etc.

-Abnormal chest X-ray findings: cardiomegaly, pulmonary edema, pleural effusion, etc.

Structural heart disease is suspected

- Symptoms: exertional dyspnea, orthopnea, etc.
- Abnormal physical examination: cardiac murmurs, pretibial pitting edema, etc.
- Abnormal ECG results: left ventricular hypertrophy, right ventricular hypertrophy, left atrial enlargement, right atrial enlargement, etc.
- Abnormal chest X-ray findings: cardiomegaly, pulmonary edema, pleural effusion, etc.

Ischemic heart disease is suspected

- Symptoms: typical chest pain, exertional dyspnea, etc.
- Abnormal ECG results: significant ST changes, pathologic Q wave, etc.

Echocardiographic evaluations

_Evaluation of LV mass and geometry

conventional echocardiography

$$\text{LV mass (gram)} = 0.8 \times 1.04 \times [(\text{LVIDd} + \text{PWTd} + \text{SWTd})^3 - \text{LVIDd}^3] + 0.6$$

$$\text{RWT} = (2 \times \text{PWTd}) / \text{LVIDd}$$

Left Ventricular Mass (LVM)

NORMAL

INCREASED

Relative Wall Thickness (RWT)

NORMAL

INCREASED



NORMAL



**CONCENTRIC
REMODELING**



**ECCENTRIC
HYPERTROPHY**



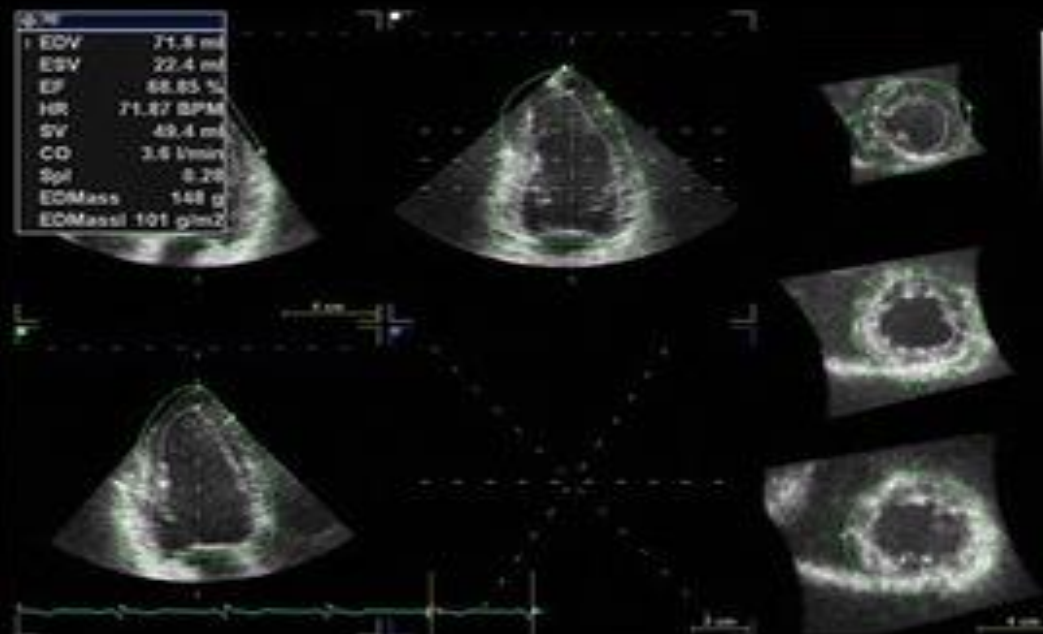
**CONCENTRIC
HYPERTROPHY**

3D echocardiography

Three-dimensional echocardiography provides **more precise measurements** theoretically. Real-time three-dimensional echocardiographic measurement of LV mass showed an excellent correlation with measurement by **magnetic resonance imaging**

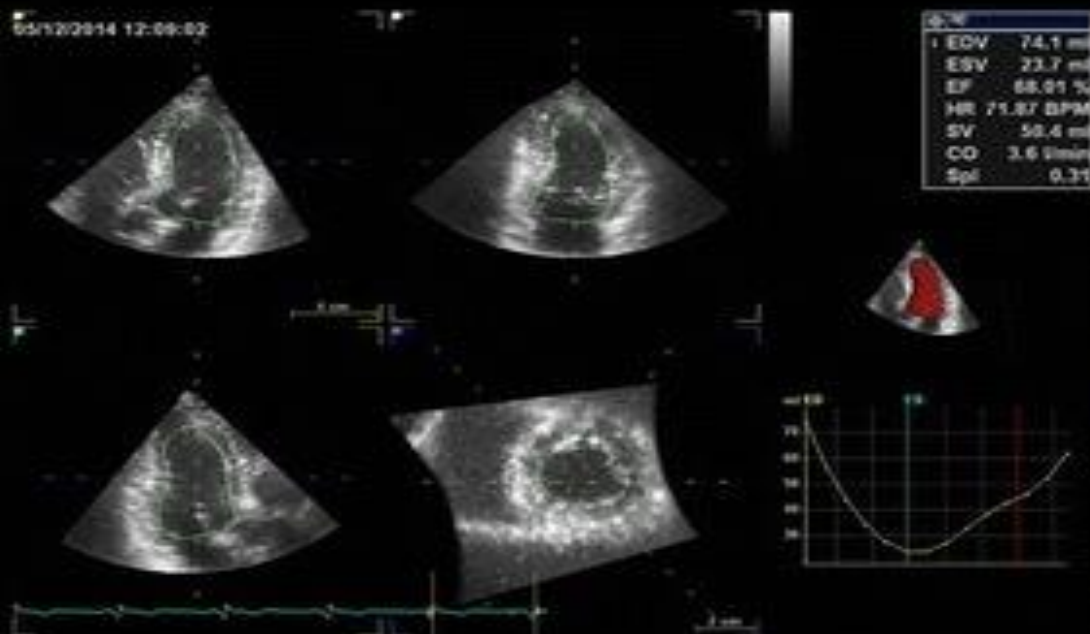
A

EDV	71.8 ml
ESV	22.4 ml
EF	68.85 %
HR	71.87 BPM
SV	49.4 ml
CO	3.6 l/min
SpI	0.29
EDMass	148 g
EDMassI	101 g/m ²

**B**

05/12/2014 12:09:02

EDV	74.1 ml
ESV	23.7 ml
EF	68.01 %
HR	71.87 BPM
SV	50.4 ml
CO	3.6 l/min
SpI	0.31



_Left ventricular systolic function

Conventional echocardiography

_ M-mode

_modified Simpson's method

3D echocardiography

Three-dimensional echocardiographic measurements have been shown high degree of agreement with the measurements by cardiac magnetic resonance imaging.

A

LVL A4C 6.8 cm
LVEDV MOD A4C 74 ml

**B**

LVL A4C 5.9 cm
LVEDV MOD A4C 27 ml

**C**

LVL A2C 7.0 cm
LVEDV MOD A2C 62 ml

**D**

LVL A2C 5.9 cm
LVEDV MOD A2C 21 ml

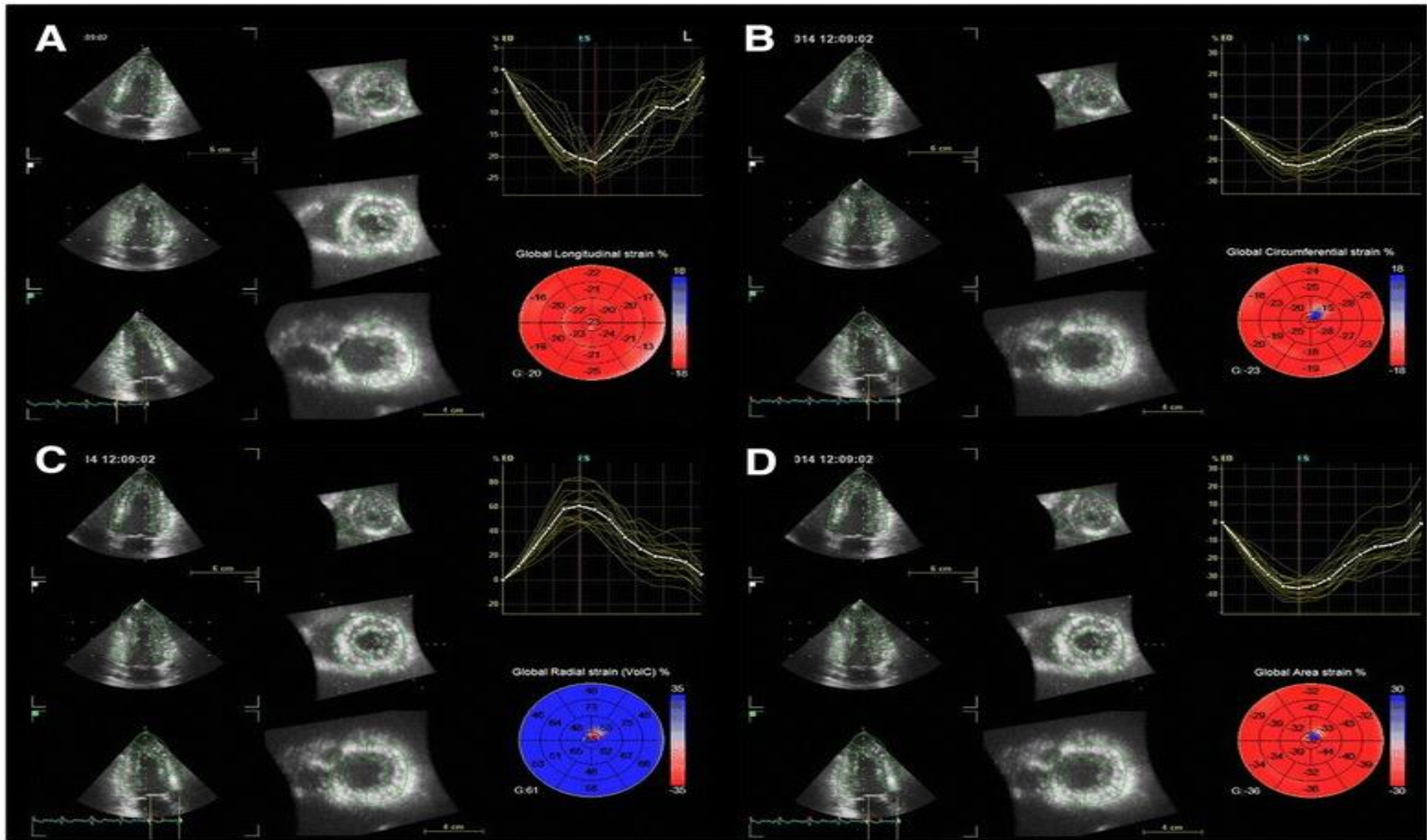


Tissue Doppler imaging

Tissue Doppler imaging is the new echocardiographic modality to measure mitral annular movement. Mitral annular velocity was decreased in hypertensive patients with normal ejection fraction, and it can be used to detect subclinical LV systolic dysfunction.

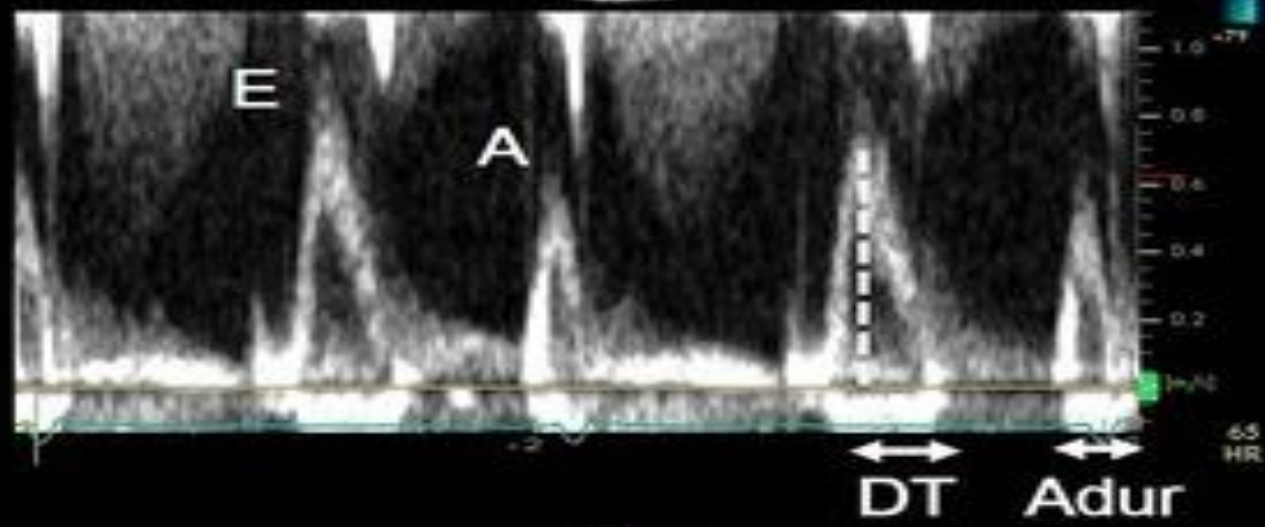
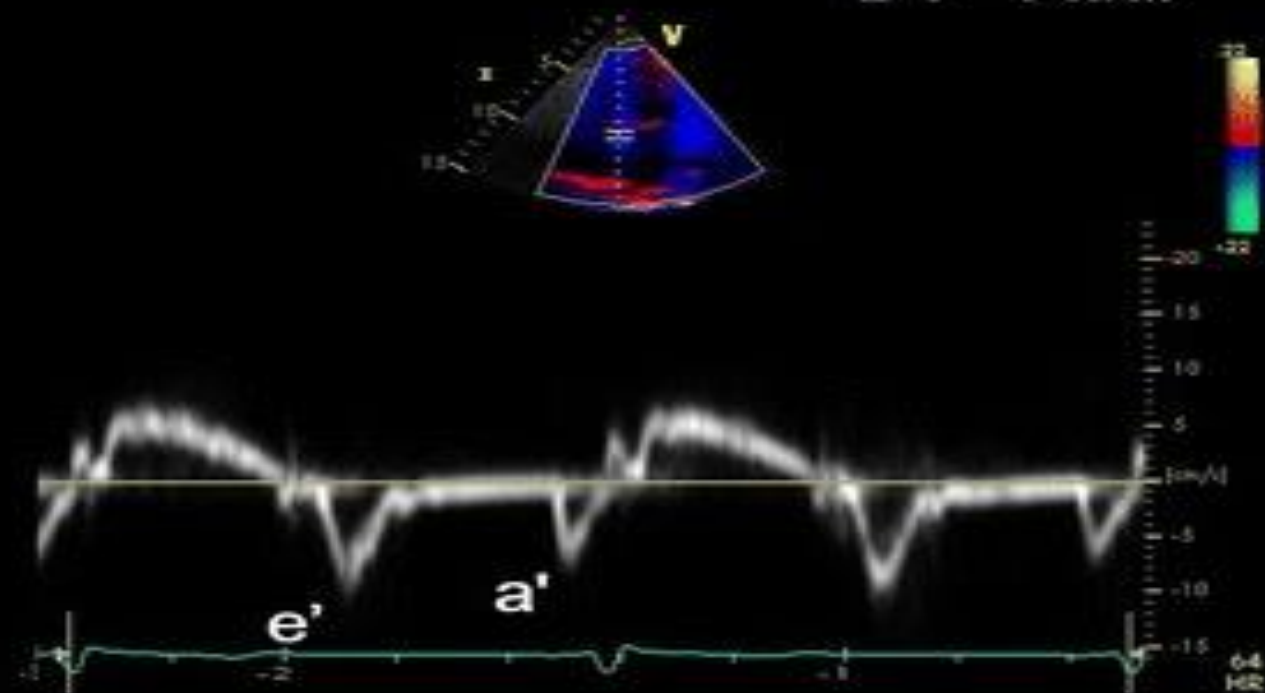
Two-dimensional speckle-tracking echocardiography

Myocardial strain can detect subclinical organ damage earlier than other conventional echocardiographic parameters



Left ventricular diastolic function

- **Mitral inflow pattern; E, A and E/A ratio**
- **Mitral annular velocity ; e', a'**
- **IVRT**
- **E/e' ratio to assess LV filling pressure**

A**B**

Left atrial size and function

- **LA enlargement is commonly associated with systemic arterial hypertension in patients without significant valvular heart disease.**
- **Increased LA size and volume can reflect the diastolic dysfunction in hypertensive patients and can be used as one of indicators of cardiovascular morbidity and mortality**



A4C



A2C

Apical 4 chamber view

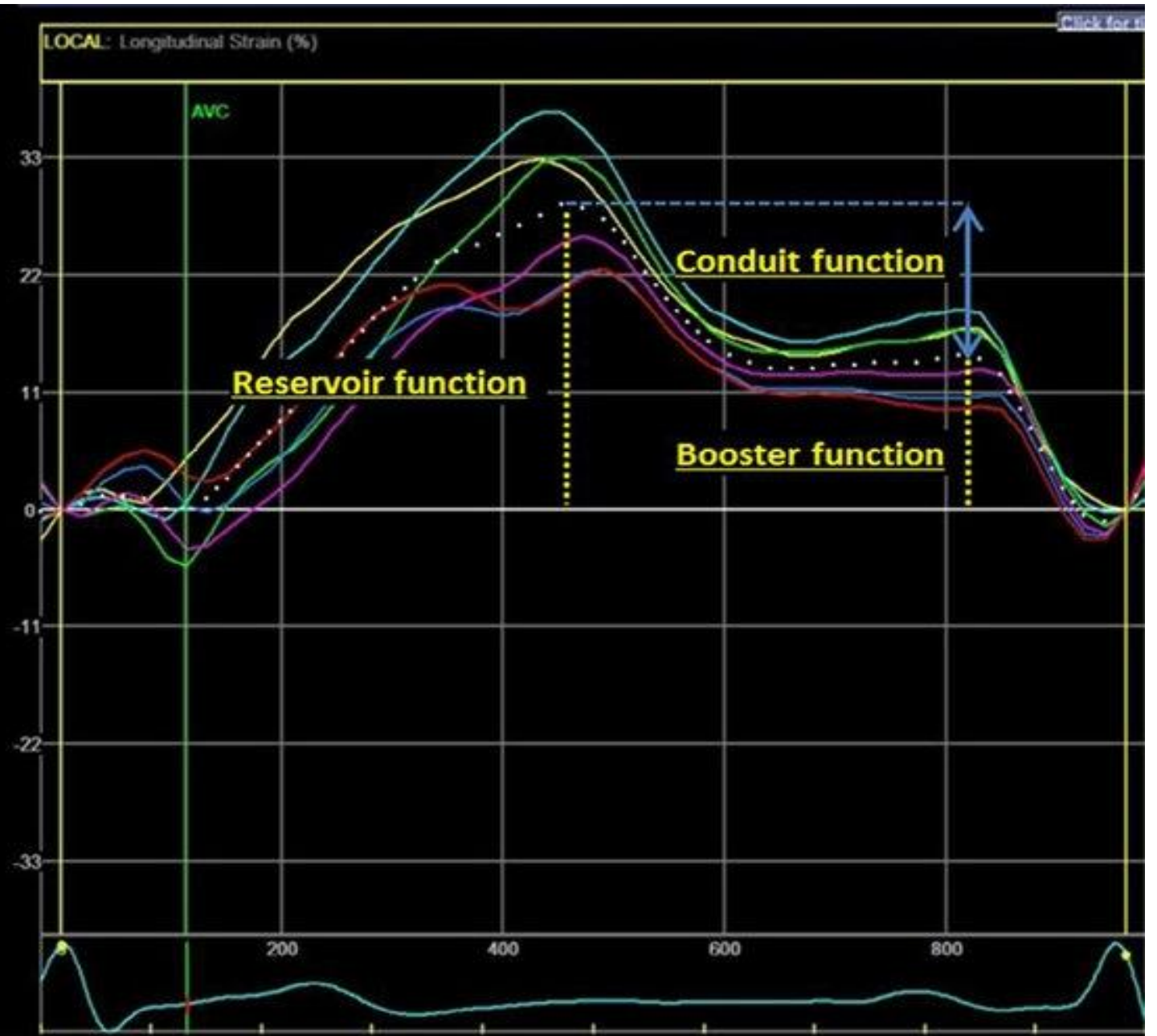
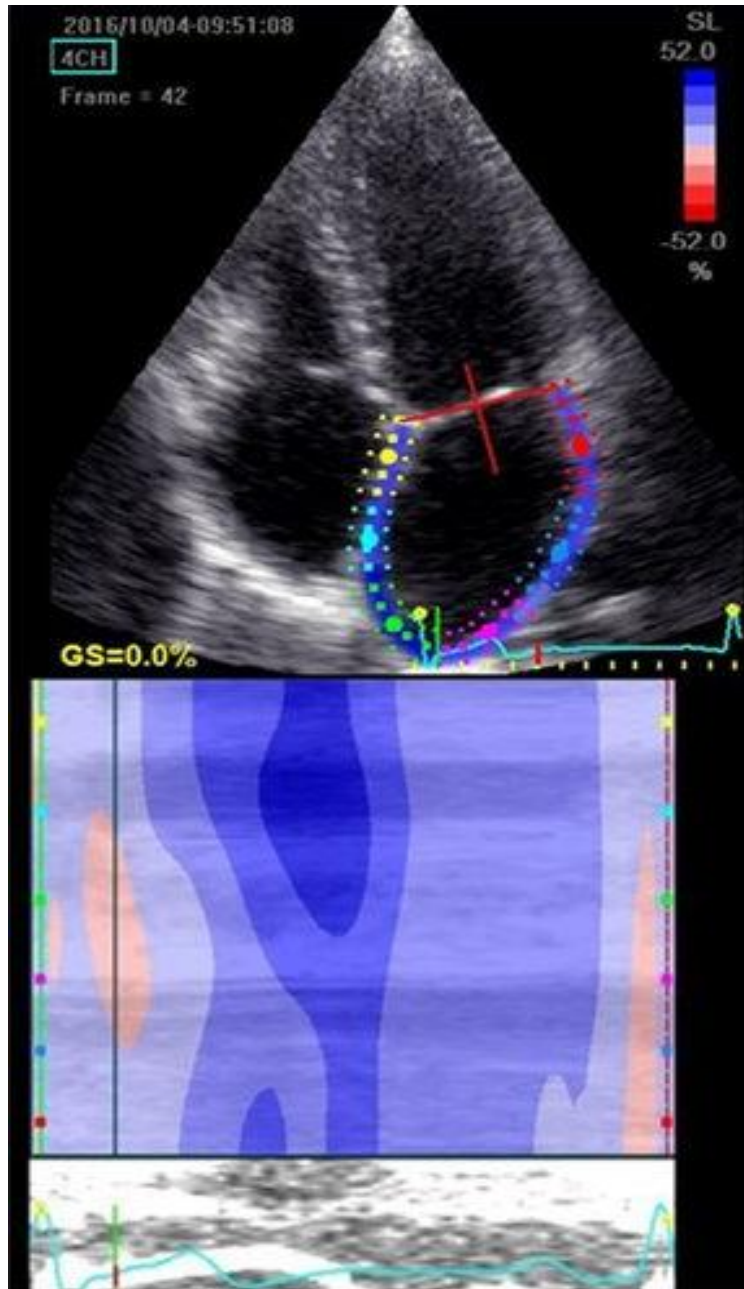


Apical 2 chamber view



$$\text{Left atrial volume} = \frac{8}{3}\pi[(A1 \times A2) / L^*]$$

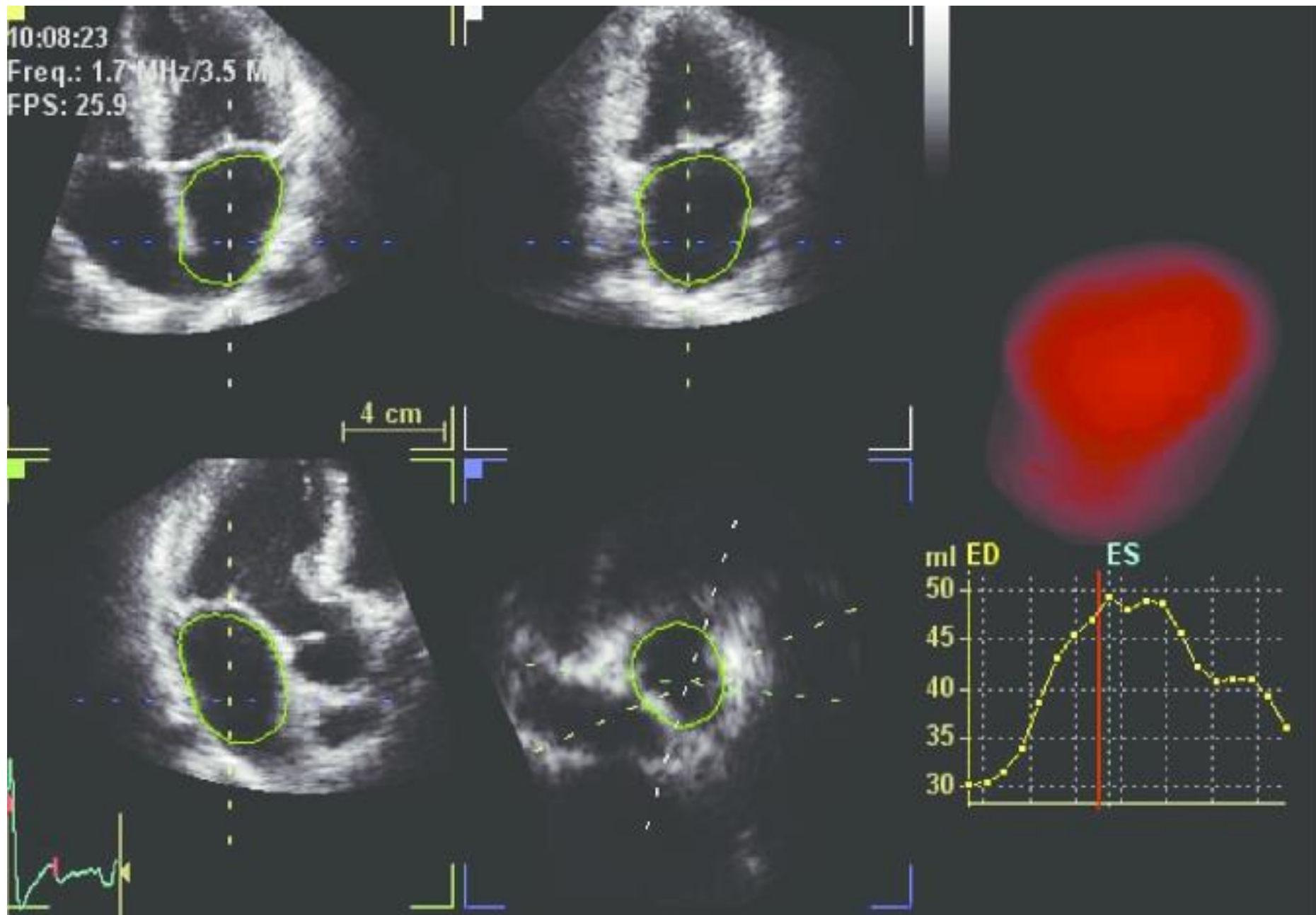
- **Two-dimensional speckle-tracking echocardiography has been used in the assessment of LA function.**
- **Three-dimensional echocardiography has been introduced in the measurement of LA size and volume, and it gives many advantages over two-dimensional echocardiography.**
- **Analysis of LA appendage can give indirect information about LA function, and impaired LA appendageal function in patients with non-dipper compared to dipper hypertensive patients.**



10:08:23

Freq.: 1.7 MHz/3.5 MHz

FPS: 25.9



Adult Echo

X7-2t
53Hz
20cm

2D
61%
C 50
P Off
Gen

06/25/2021 08:41:50AM

TIS0.2 MI 0.2

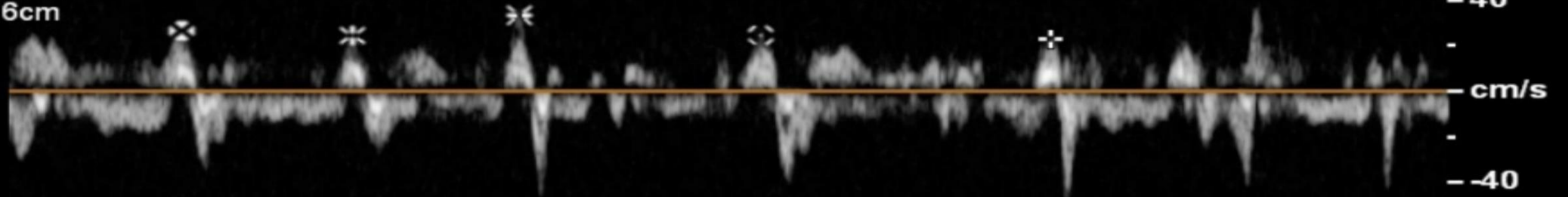


M4

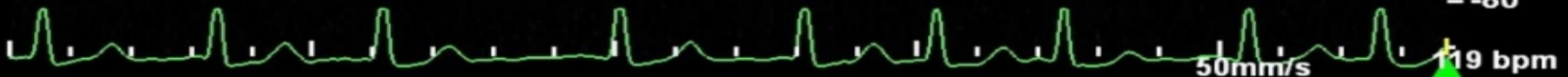


PW
50%
WF 150Hz
SV4.0mm
2.9MHz
7.6cm

✦ Vel 22.9 cm/s
PG 0 mmHg



PAT T: 37.0C
TEE T: 39.2C



Other echocardiographic findings in hypertensive patients

Pulmonary hypertension

- $PASP = RVSP = RAP + 4 \times TR V_{max}^2$.
- Right ventricular outflow tract acceleration time (<80ms).

Ischemic heart disease, dilatation of ascending aorta, and aortic valve sclerosis or stenosis can be found.

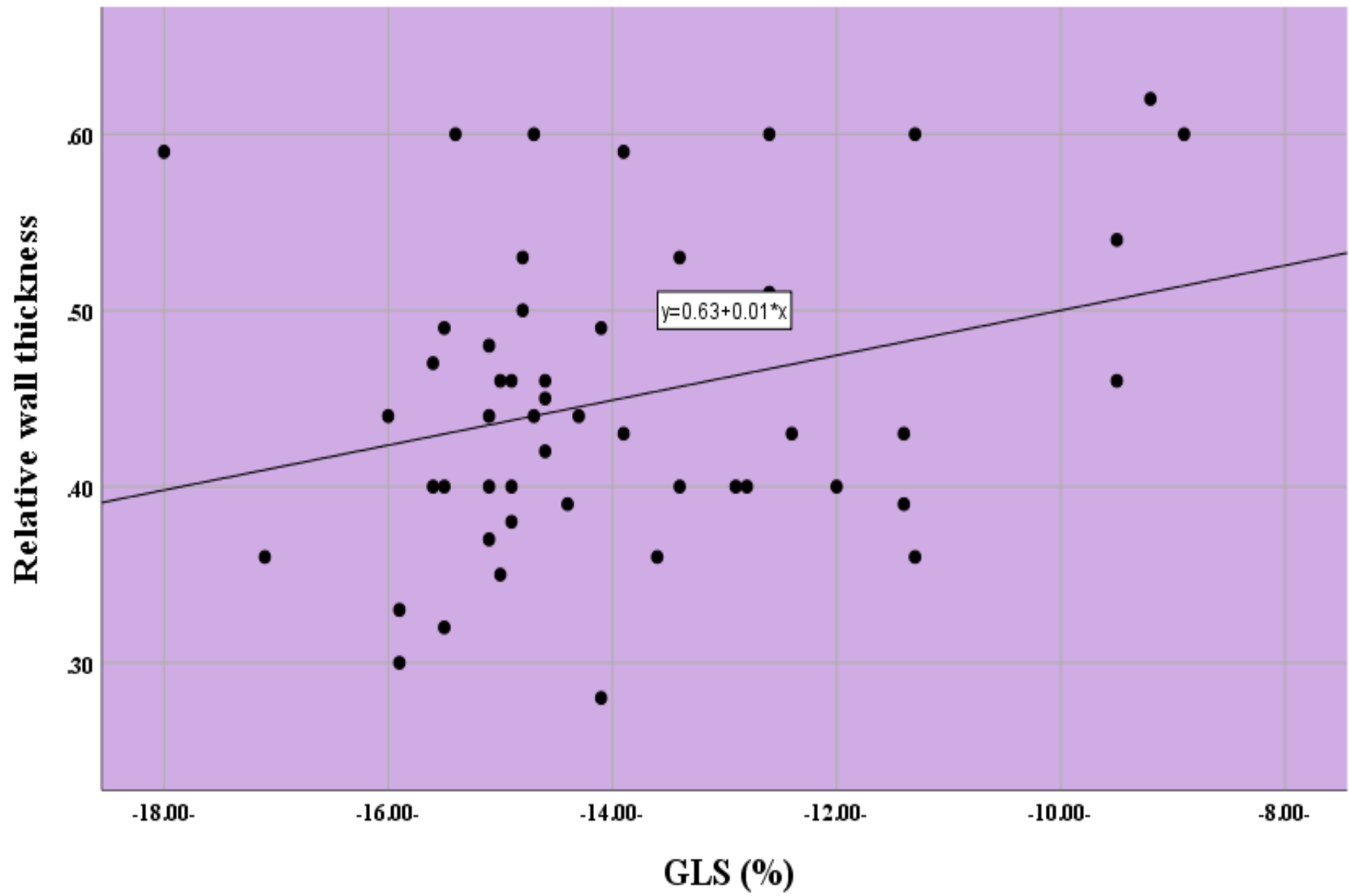
**prognostic significance of
hypertension by
echocardiography**

- **LV hypertrophy is recognized as evidence of target organ damage in hypertension by the Joint National Committee for the prevention, detection, and evaluation of high blood pressure.**
- **The type of LV remodelling (concentric remodelling, eccentric hypertrophy, and concentric hypertrophy) is predictive of the incidence of CV event.**

- **Global measure of LV chamber function, is used to distinguish **systolic (EF <50%)** from **diastolic HF (EF >50%)**, and is a reliable method for predicting primary cardiac events and cardiac mortality in individuals.**
- **Global longitudinal strain has shown a prognostic value in patients with normal EF, where the prognostic information from EF is less useful. 2D strain has been shown to be abnormal in hypertensive patients with normal EF, as well as in pre-hypertension.**

- Among tissue Doppler parameters, **S'** has shown the best correlation with LVEF and significant clinical outcomes such as rehospitalization and reduced survival, although measurements at the septal and lateral side in the apical four-chamber view have proved to produce good results (**$S' < 7$ cm/s showing 93% sensitivity and 87% specificity to identify patients with LVEF <45%**). Other authors have reported slightly higher diagnostic power with measurements at six sites from the apical four-chamber, two-chamber and long-axis views (**sixsite average $s' > 5.4$ cm/s showing 88% sensitivity and 97% specificity for LVEF >50%**).

- And in the same context, another study had been done by faculty of medicine in university of Babylon in Marjan medical teaching city by **Dr. Sarah AL_Essa and Professor Dr. Oday Al_Salihi** to see the correlation between conventional 2D echocardiographic parameters (LV mass index and RWT) with Global longitudinal strain by 2D-speckle tracking echocardiography in hypertensive patients and compared to control subjects, Our study have reported **strong correlation between increasing in RWT with reduction in LV GLS and LV GLS has reduced in hypertensive patients even had normal LV mass index.**



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Paper ID: JRTDD_22_01_0015

Paper Title: Correlation between the posterior left ventricular wall thickness and relative wall thickness with global longitudinal strain (GLS) in hypertension

We are pleased to inform you that your manuscript has been accepted for publication in Journal for ReAttach Therapy and Developmental Diversities (E-ISSN:2589-7799) in Current Issue of 2022.

The blind peer review process results are given below

----- REVIEW 1 -----

Review Decision 1: Accepted

1. Originality: 91%
2. Article scope: 88%
3. Understandable: Yes
4. References: Cited Properly
5. Result: Satisfactory

----- REVIEW 2 -----

Review Decision 2: Accepted

1. Originality: 87%
2. Article scope: 75%
3. Understandable: Yes
4. References: Cited Properly
5. Result: Satisfactory

Final Decision: Accepted

For any further query feel free to contact us.



Regards
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- Finally, all echocardiography reports in patients with hypertension should include specific comments about LV mass index, RWT, systolic function, diastolic function grade, left atrial volume, and about normal vs. elevated LV filling pressure (**usually based on E/e'**).

The image features the text "Thank You!" in a bold, white, sans-serif font. The text is centered and has a slight 3D effect with a drop shadow. It is surrounded by a dense arrangement of autumn leaves in various colors including red, orange, yellow, and brown. The leaves are layered and overlap, creating a textured, natural-looking border around the text. The entire composition is set against a plain white background.

Thank You!