Correlation of LV Longitudinal Strain by 2D Speckle Tracking with Cardiovascular risk in Elderly. (A pilot study of EGAT-Echo study.)

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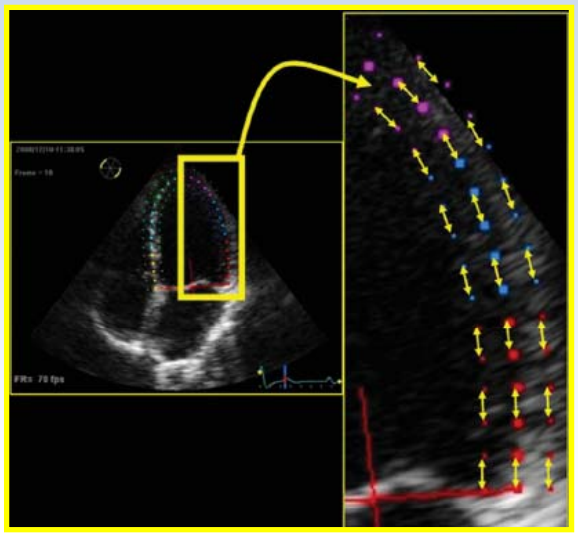
Ramathibbodi hospital

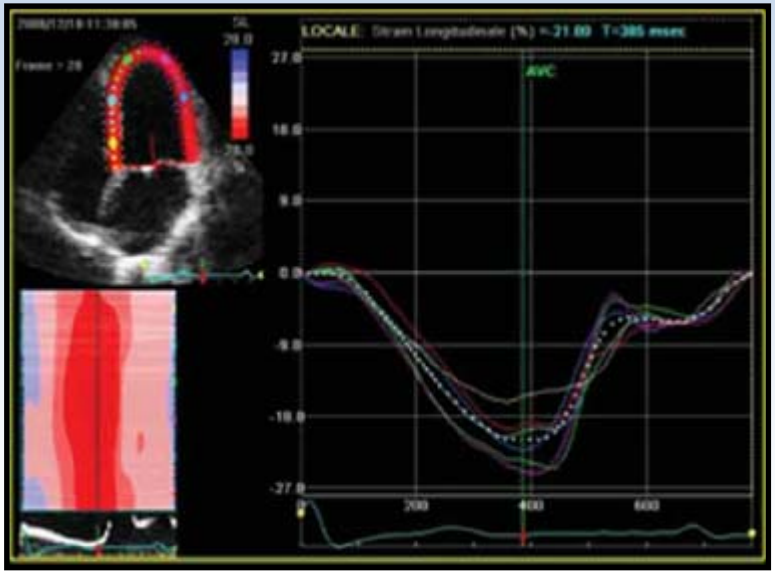
INTRODUCTION

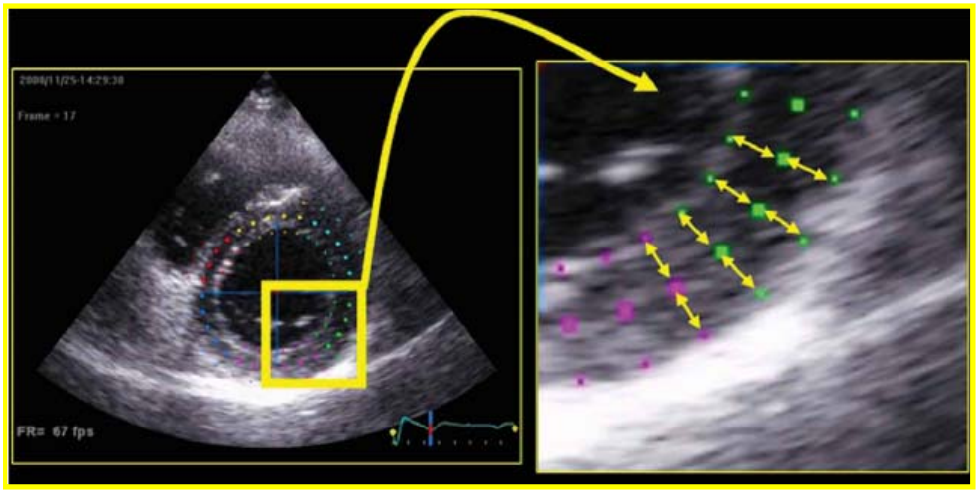
- Echocardiogram is a standard procedure in evaluation of Left ventricular function

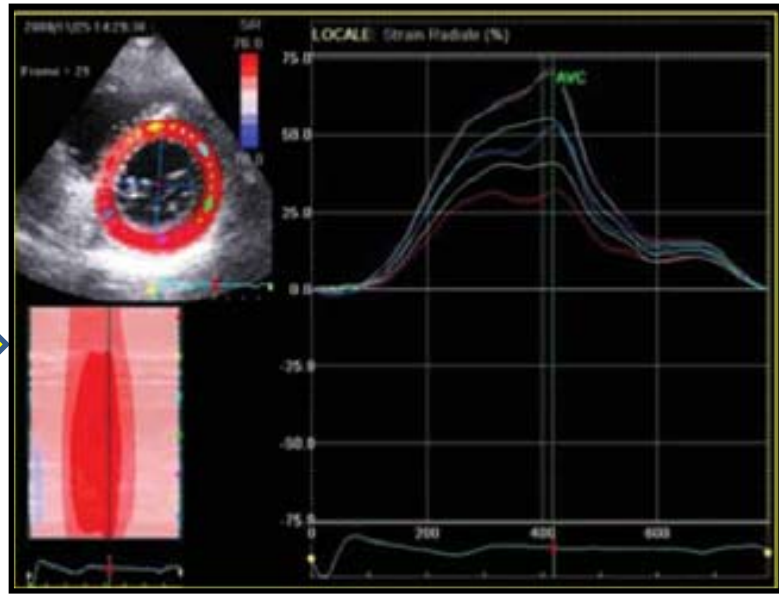
- 2 D speckle tracking is a new tool to measure myocardial deformation and allow quantitative analysis of global and regional myocardial function

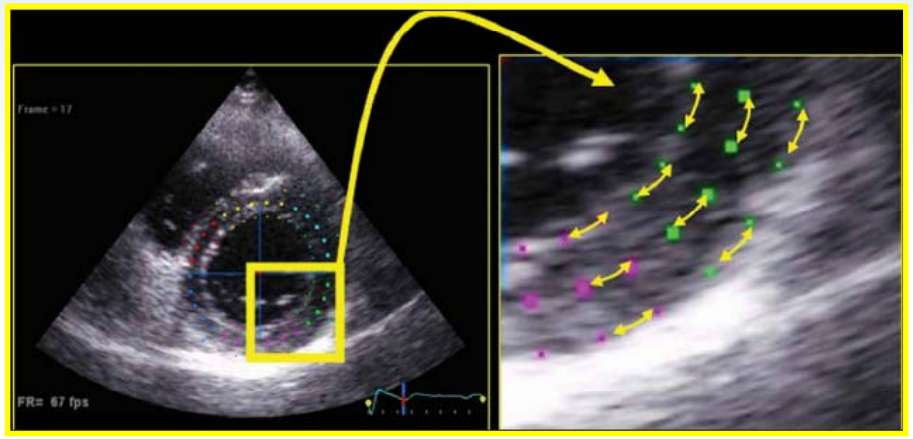
Speckle tracking : strain







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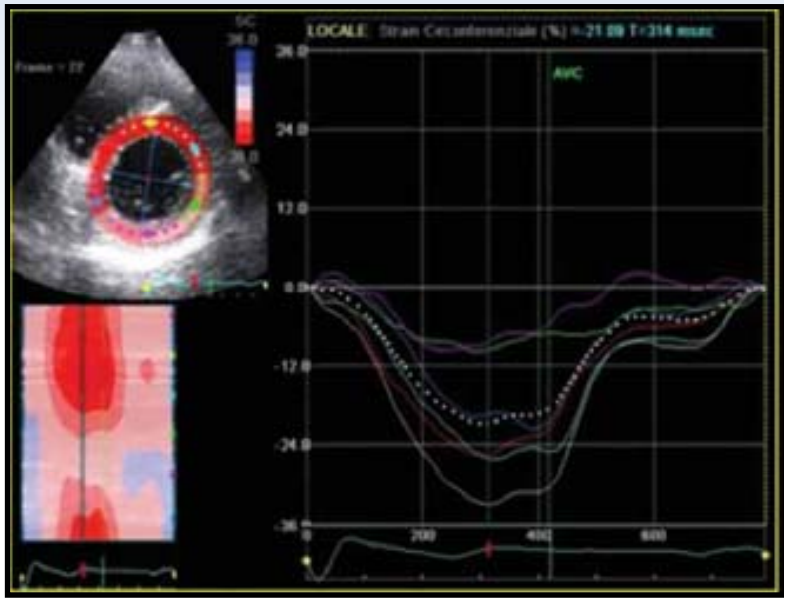
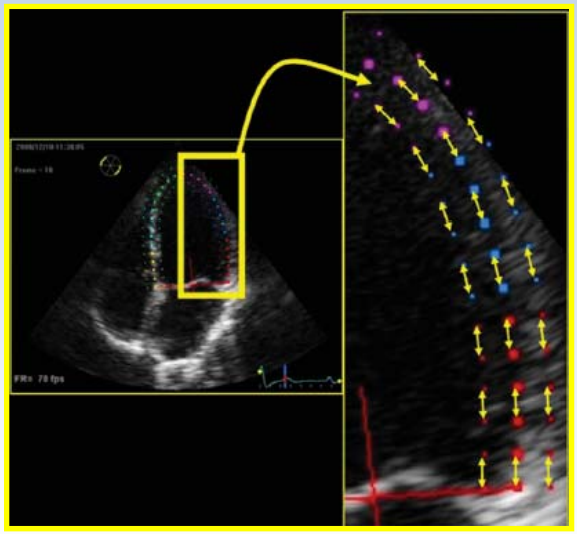
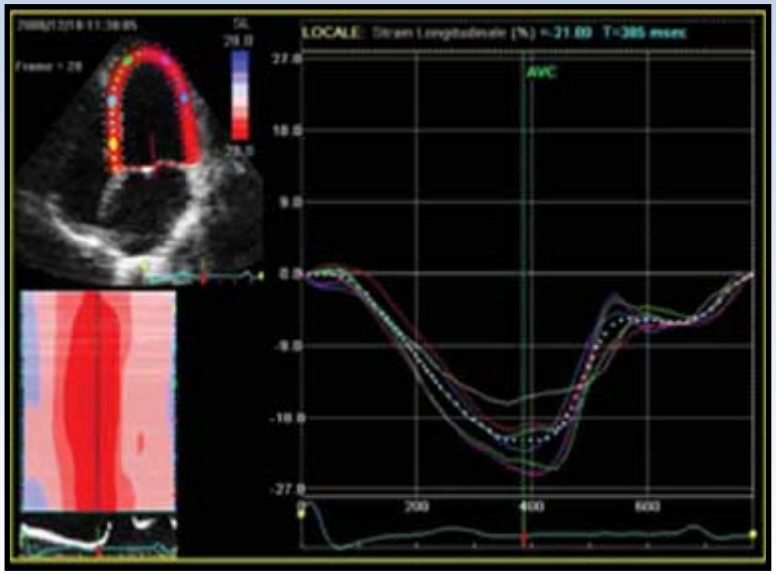

LOCALE
AVC





Speckle tracking : Strain

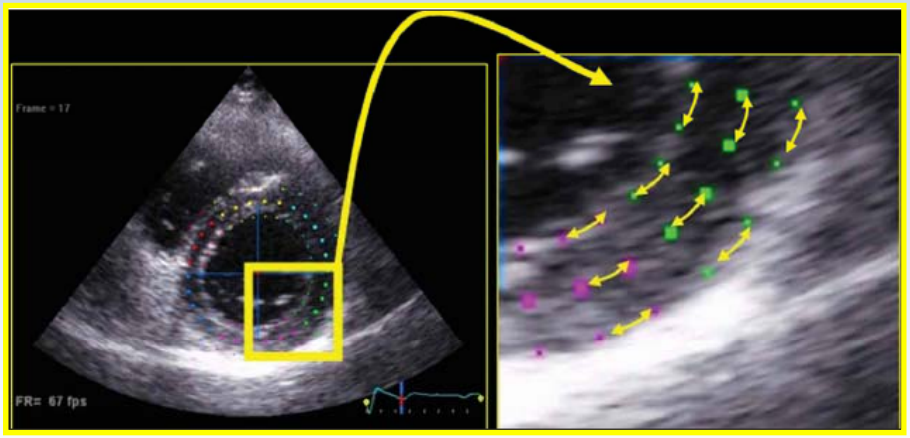
- Tissue imaging evaluation myocardial deformation
- Good Quantitative assessment
- Angle independence
- Validated to CMR and Sonomicrometry
- Minimal bias (low intra and interobserver variability)

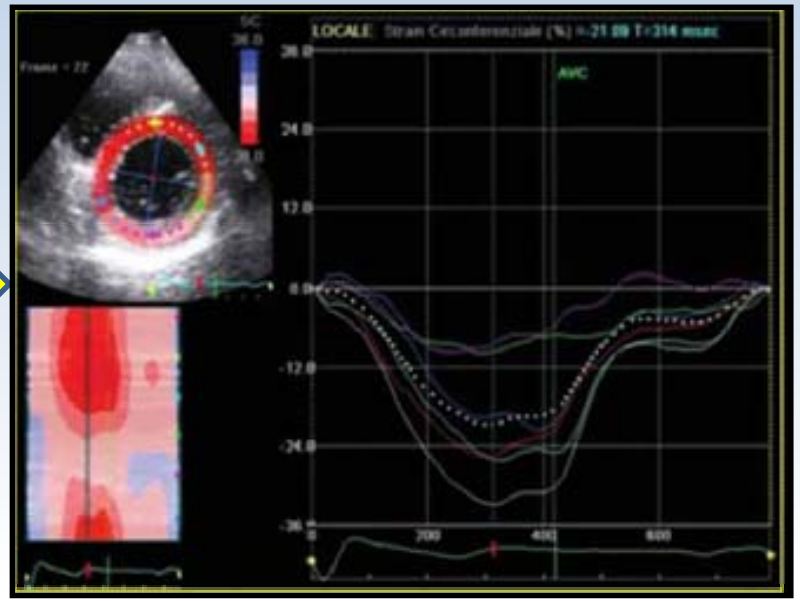
INTRODUCTION

- Left ventricular function altered with age and previous study had shown reduction of longitudinal strain in elderly (1)
- Longitudinal strain was shown to be impaired before other directions of strain in those with cardiovascular risk and without overt cardiac disease (2)

1. Jing Ping Sun et al. Int J cardiol; 2012

2. J Am Soc Echocardiogram 2008; 21: 1138-1144.





- Non invasive for assessment of LV (Global and and regional) deformation and torsion
- Angle independence
- Validated to CMR and Sonomicrometry
- Minimal bias (low intra and interobserver variability)
- Valid in patient with and without RWMA

INTRODUCTION

- There are no study of correlation to demonstrate relationship between left ventricular longitudinal strain by 2D speckle tracking and cardiovascular risk factors in Thai elderly.

- This study will be the pilot study of relationship between ventricular longitudinal strain and cardiovascular risk factors.

Objective

Primary outcome

Determination of the relationship between 2D STE of LV longitudinal strain in elderly with and without cardiovascular risk.

Secondary outcome

Demonstrating correlation 2 D STE longitudinal strain and CAVI.

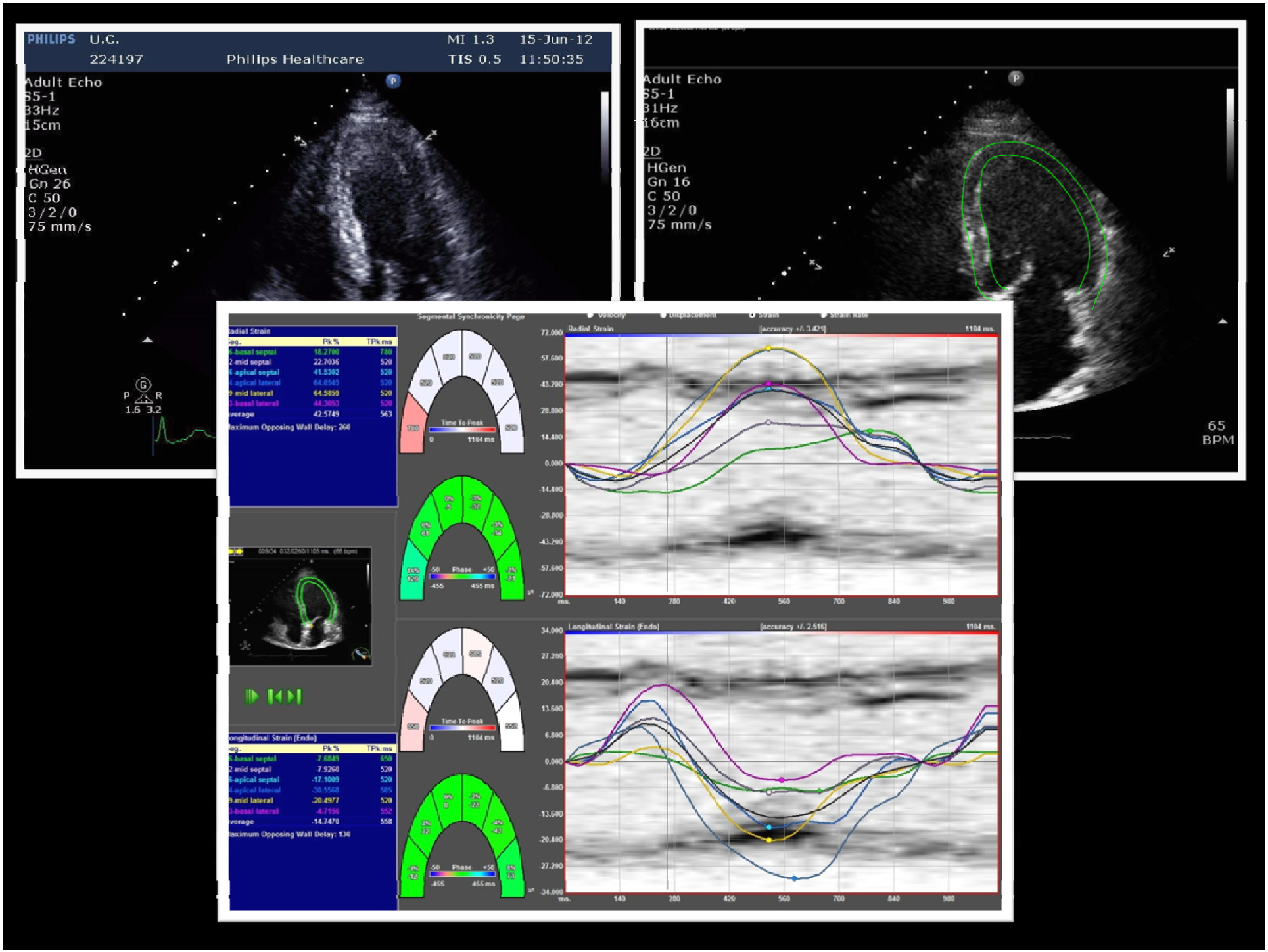
Data collection

Cardiovascular disease risk factors (CVD risk factors) data collection

- HT
- Diabetes mellitus
- Tobacco use
- History of CVA,MI
- Dyslipidemia
- Age
- Gender
- Kidney function
- BMI

Echocardiography data

All raw datasets were transferred to the core laboratory of Ramathibodi hospital. The LV Longitudinal Strain by 2-D speckle tracking analysis was performed using speckle tracking software from **Tomtec software.**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224197
Philips Healthcare
MI 1.3
TIS 0.5
15-Jun-12
11:50:35
Adult Echo
S5-1
33Hz
15cm
2D
HGen
Gn 26
C 50
3/2/0
75 mm/s
Adult Echo
S5-1
31Hz
16cm
2D
HGen
Gn 16
C 50
3/2/0
75 mm/s
65
BPM
Segmental Synchronicity Page
Radial Strain
Pk %
TPk ms
6-basal septal 18.2700 780
2-mid septal 22.7036 520
6-apical septal 41.5302 520
4-apical lateral 64.0545 520
9-mid lateral 64.5859 520
3-basal lateral 44.5053 520
Average 42.5749 563
Maximum Opposing Wall Delay: 260
Time To Peak
0
1104 ms
Phase
-50
+50
-455
455 ms
Radial Strain
[accuracy +/- 3.421]
1104 ms.
72.000
57.600
43.200
28.800
14.400
0.000
-14.400
-28.800
-43.200
-57.600
-72.000
ms.
140
280
420
560
700
840
980
Longitudinal Strain (Endo)
Pk %
TPk ms
6-basal septal -7.6845 650
2-mid septal -7.9260 520
6-apical septal -17.1009 520
4-apical lateral -30.5568 585
9-mid lateral -20.4977 520
3-basal lateral -4.7156 552
Average -14.7470 558
Maximum Opposing Wall Delay: 130
Longitudinal Strain (Endo)
[accuracy +/- 2.516]
1104 ms.
34.000
27.200
20.400
13.600
6.800
0.000
-6.800
-13.600
-20.400
-27.200
-34.000

Study design/Statistic

Study design

Crossectional -Correlational research design.

Statistic

- Descriptive statistics, mean, standard deviation, absolute number, percentage will used for subject demographic explanation.
- Univariate regression and Multivariate regression (stepwise method) analysis will be used for demonstrating correlation between LV Left ventricular 2 D speckle tracking longitudinal strain with cardiovascular risk in the elderly and CAVI.
- A p-value <0.05 was considered statistically significant. All statistics analysis are calculated by SPSS 16.0 Program.

Results

Baseline characteristics

Baseline characteristics

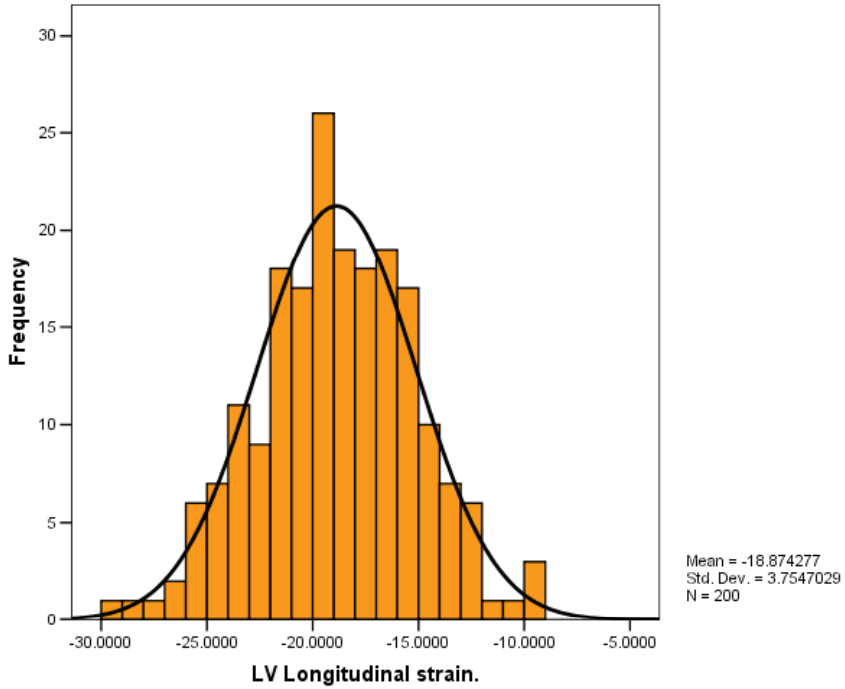
- **Total 350subjects underwent echocardiogram was reviewed. There were 200 subjects to calculate LV Longitudinal strain because 150 subjects were excluded due to poor echocardiogram images.**

LV Longitudinal strain (N= 200 subjects)

- **Mean ± SD = -18.8743 ± 3.7547**

  95%CI = -19.3978 to -18.3507
- **Kolmogorov-Smirnov test (K-S test)**

  ***p*-value = 0.200>> normal distribution**



Baseline characteristic and risk factors.

		Mean ± SD	n	n %
Left ventricular mass (g) (n=192)		214.4 ± 84.1		
Left ventricular C (g) (n=192)		172.1 ± 67.3		
Ejection fraction (%) (n=192)		71.43 ± 9.58		
Left ventricular Longitudinal strain (n=200)		-18.8743 ± 3.7547		
Age at echocardiogram (years) (n=196) (60 – 82 yr)		68.98 ± 4.91		
Gender (n=199)	Female		73	36.68%
	Male		126	63.32%
Hypertension (n=200)	Have not hypertension		91	45.50%
	Have hypertension.		109	54.50%
Smoking (n=198)	Never smoking.		110	55.56%
	Smoker (Both current and former).		88	44.44%
Diabetes mellitus (n=200)	Have not Diabetes mellitus.		158	79.00%
	Have Diabetes mellitus.		42	21.00%
Stroke (n=200)	Have **not** experienced stroke		197	98.50%
	Have experienced stroke		3	1.50%
Dyslipidemia (n=200)	Have **not** dyslipidemia		46	23.00%
	Have dyslipidemia		154	77.00%

Baseline characteristic and risk factors.

		Mean ± SD	n	n %
CAD (n=200)	Have not current or previous CAD		188	94.00%
	Have current or previous CAD		12	6.00%
BMI (kg/m^2) (n=194)		24.10±2.91		
Weight (n=194)	Normal weight		123	63.40%
	Over weight		67	34.54%
	Obesity		4	2.06%
Age risk (n=196)	Male <= 55 and Female <=65 years		19	9.69%
	Male > 55 and Female > 65 years		177	90.31%
GFR (n=195)	Normal GFR		109	55.9%
	Abnormal GFR (< 60 ml/min)		86	44.1%
Peripheral Artery disease (PAD) (n=198)	Have not PAD as underlying		196	98.99%
	Have PAD as underlying disease		2	1.01%

Baseline characteristic and risk factors.

		Mean ± SD	n	n %
Cardio-Ankle Vascular Index (CAVI) (n=181)				
Right CAVI score		9.04±1.27		
Left CAVI score		9.01±1.30		
CAVI criteria	Normal (CAVI score 8.0)		20	11.05%
	Border line (9 > CAVI >=8)		59	32.60%
	Possible CAVI >=9 Arteroisclerosis		102	56.35%

Baseline characteristic and risk factors.

			Mean ± SD	n	n %
Cardio-Ankle Vascular Index (CAVI) (n=181)					
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	Border line (9 > CAVI >=8)			59	32.60%
	Possible CAVI >=9 Arteroisclerosis			102	56.35%
Ankle Brachial Index					
Left Ankle Brachial Index (n=182)			1.11±0.09		
Left Ankle Brachial Index		Normal		182	100.00%
		Abnormal (ABI <0.9)		0	.00%
Right Ankle Brachial Index (n=182)			1.12± 0.10		
Right Ankle Brachial Index		Normal		182	100.00%
		Abnormal (ABI <0.9)		0	.00%
Ankle Brachial Index (n=182)		Normal		182	100.00%
		Abnormal (ABI <0.9)		0	.00%

Baseline characteristic and risk factors.

		Mean ± SD	n	n %
Lipid profile test				
Total Cholesterol (n=200)		205.80± 43.27		
Cholesterol level	<240 mg/dL		163	81.50%
	≥240 mg/dL		37	18.50%
Triglyceride (n=200)		122.85± 62.96		
Triglyceride level	< 200 mg/dL		183	91.50%
	≥200 mg/dL		17	8.50%
HDLC (n=200)		61.55± 18.05		
HDLC level	≥ 40 mg/dL		188	94.00%
	<40 mg/dL		12	6.00%
LDLC (n=200)		133.14± 37.03		
LDLC level	< 160 mg/dL		157	78.50%
	≥160 mg/dL		43	21.50%
Lipid Profile test	Normal Lipid Profile test		136	68.00%
	Abnormal Lipid Profile test		64	32.00%

Baseline characteristic and risk factors.

		Mean ± SD	n	n %
FBS >=126 mg/dl and/or HbA1C > 6.5%	No		165	82.50%
(n=200)	Yes		35	17.50%

Univariate analysis

- **Linear regression analysis was used to demonstrate relationship between LV longitudinal strains with each factor.**
- **The significant relation factors for LV longitudinal strain were**
  - Gender (*p*-value 0.001)
  - Hypertension (*p*-value 0.002)
  - Smoking (*p*-value 0.011)
  - Diabetes mellitus (*p*-value < 0.001)
  - Coronary artery disease (*p*-value 0.002)

Univariate analysis

		n	Left ventricular LG strain Mean ± SD	*Adjusted r^2*	*B*	*95% CI*	*p-value**
Male Gender	**No**	**73**	**-19.9573 ± 3.5822**		**1.000**	**Reference**	
	Yes	**126**	**-18.2054 ± 3.7011**	**0.046**	**1.752**	**0.691 to 2.813**	**0.001***
Hypertension	**No**	**91**	**-19.7468 ± 3.4890**		**1.000**	**Reference**	
	Yes	**109**	**-18.1459 ± 3.8282**	**0.040**	**1.601**	**0.571 to 2.631**	**0.002***
Current smoker or former	**No**	**110**	**-19.4366 ± 3.6345**		**1.000**	**Reference**	
smoker	**Yes**	**88**	**-18.0855 ± 3.7699**	**0.027**	**1.351**	**0.309 to 2.393**	**0.011***
Diabetes mellitus	**No**	**158**	**-19.4215 ± 3.7211**		**1.000**	**Reference**	
	Yes	**42**	**-16.8157 ± 3.1479**	**0.076**	**2.606**	**1.370 to 3.842**	**<0.001***
Stroke	**No**	**197**	**-18.8560 ± 3.7608**		**1.000**	**Reference**	
	Yes	**3**	**-20.0739 ± 3.8017**	**-0.003**	**-1.218**	**-5.533 to 3.097**	**0.578**
Dyslipidemia	**No**	**46**	**-19.1225 ± 3.9226**		**1.000**	**Reference**	
	Yes	**154**	**-18.8001 ± 3.7131**	**-0.004**	**0.322**	**-0.924 to 1.569**	**0.611**
CAD	**No**	**188**	**-19.0762 ± 3.6985**		**1.000**	**Reference**	
	Yes	**12**	**-15.7113 ± 3.3007**	**0.046**	**3.365**	**1.206 to 5.524**	**0.002***
Weight	**Normal**	**123**	**-18.8072 ± 3.8154**		**1.000**	**Reference**	
	Overweight and Obesity	**71**	**-18.8473 ± 3.6698**	**0.000**	**-0.040**	**1.370 to 3.842**	**0.943**

Univariate analysis

		n	Left ventricular LG strain	*Adjusted* r^2	*B*	*95% CI*	*p-value**
			Mean ± SD				
Male > 55 and Female > 65 years	No	19	-20.1622 ± 3.0920		1.000	Reference	
	Yes	177	-18.6719 ± 3.8040	0.014	1.490	-0.292 to 3.273	0.101
Abnormal kidney function	No	110	-19.1655 ± 3.5918		1.000	Reference	
	Yes	88	-18.4495 ± 3.9344	0.004	0.716	-0.341 to 1.773	0.183
Peripheral Artery disease (PAD)	No	196	-18.8235 ± 3.7664		1.000	Reference	
	Yes	2	-21.1739 ± 0.9283	-0.001	-2.350	-7.617 to 2.916	0.380
Chronic Kidney Disease	No	191	-18.8993 ± 3.7552		1.000	Reference	
	Yes	7	-17.4286 ± 3.7441	0.000	1.471	-1.379 to 4.320	0.310
Abnormal GFR (< 60 ml/min)	No	109	-19.0867 ± 3.6033		1.000	Reference	
	Yes	86	-18.4343 ± 3.9346	0.002	0.652	-0.415 to 1.720	0.230

Univariate analysis

		n	Left ventricular LG strain Mean ± SD	*Adjusted* r^2	*B*	*95% CI*	*p-value**
Cardio-Ankle Vascular Index (CAVI)	Normal (CAVI < 8.0)	20	-18.1978 ± 3.3924		1.000	Reference	
	Border line and Possible Arteroisclerosis (9 > CAVI >=8) And CAVI >=9)	161	-19.0864 ± 3.8150	0.000	-0.889	-2.654 to 0.876	0.322
FBS >=126	No	183	-18.9965 ± 3.7606		1.000	Reference	
	Yes	17	-17.5588 ± 3.5309	0.006	1.438	-0.434 to 3.309	0.131
HbA1C > 6.5%	No	172	-19.1560 ± 3.7172		1.000	Reference	
	Yes	28	-17.1440 ± 3.5756	0.030	2.012	0.526 to 3.498	0.008*

Multivariate analysis

Multivariate analysis

- **Multivariate Regression analysis, stepwise method was analyzed to demonstrate relationship between LV longitudinal strain with significant factors from univariate analysis.**
  - Gender
  - Hypertension,
  - Smoking,
  - Diabetes mellitus,
  - Coronary artery disease

Multivariate analysis

Multivariate analysis

- **The result shown that diabetes mellitus, coronary artery disease, and HT were significant risk factors strongly associated with LV longitudinal strain *(p-value = < 0.001, Adjusted r^2 = 0.127)***

	Unstandardized		standardized	Sig.	95% CI			Adjusted r^2	p-value
	B	Std. Error	Beta						
Constant	-20.092	0.376		0.000	-20.833	to	-19.350	0.127	< 0.001
Diabetes mellitus	2.315	0.622	0.252	0.000	1.089	to	3.541		
CAD	2.955	1.056	0.187	0.006	0.872	to	5.037		
Hypertension	1.016	.514	0.135	0.049	0.003	to	2.030		

- **Regression model show LV longitudinal strain of the subject without diabetes mellitus, coronary artery, and COPD were *-20.092 (95% CI = -20.833 to -19.350).***

Multivariate analysis

Multivariate analysis

- **The result shown that diabetes mellitus, coronary artery disease, HT were significant risk factors strongly associated with LV longitudinal strain** ***(p-value = < 0.001, Adjusted r^2 = 0.130).***

- **Regression model show LV longitudinal strain of the subject without diabetes mellitus, coronary artery, and COPD were** ***-19.569 (95% CI = -20.136 to -19.002).***

Conclusion

- **Diabetes mellitus, coronary artery disease, and HT were significant risk factors strongly associated with LV longitudinal strain.**

  (The subjects without theses factor will have longer LV strain than the subjects who have DM, CAD and HT)

- **There was no relationship between CAVI and LV strain.**

Conclusion

- Diabetes mellitus, coronary artery disease, and COPD were significant risk factors strongly associated with LV longitudinal strain. The subjects without theses factor will have longer LV strain than the subjects who have DM, CAD and COPD.
- Regression model between DM, CAD and COPD and LV was

LV longitudinal strain

= (-20.092) + 2.315 (DM 0, 1) + 2.955 (CAD 0, 1)+ 1.016(HT 0,1)

- Normal LV Longitudinal Strain in elderly was

-20.092, 95% CI = -20.833 to -19.350

- There was no relationship between CAVI and LV strain.

Acknowledge

ศ.นพ.ปิยะมิตร ศรีธรา

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อ.นพ.ปริญญ์ วาทีสาธกกิจ

คุณนิศากร ทองมั่ง

ทีมงาน EGAT


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