Relationship Between Tei index and Left Ventricular Geometric Patterns in Hypertensive Patients

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ABSTRACT:

BACKGROUND :

Various left ventricular geometric patterns occur in hypertension and may affect the cardiovascular risk profile of hypertensive subjects. Tei index is a combined index of systolic and diastolic functions and has been shown to be a predictor of cardiovascular outcome in heart diseases.

OBJECTIVE:

The aim of this study was to investigate the relationship between Tei index and left ventricular (LV) geometry in hypertensive patients.

METHODS :

Two dimensional-guided M-mode echocardiography and Doppler study were performed in ١٢٢ hypertensive patients and ٦٧ control subjects. This study was conducted at Baghdad Medical City / Teaching Hospital and Alshahed Mohammed B. Alhakem Hospital in Alshulla city . According to the value of relative wall thickness (RWT) and left ventricular mass index (LVMI), hypertensive patients were subdivided into four geometric patterns. The Tei index was obtained from the summation of isovolumic relaxation time (IVRT) and isovolumic contraction time (IVCT), divided by the ejection time. Statistical analysis was done using SPSS ١٧,٠.

RESULTS:

This study showed that the Tei index was significantly higher among the hypertensive patients with concentric hypertrophy(CH), eccentric hypertrophy(EH), concentric remodeling and normal geometry compared with the control group(٠,٨١±١.١, ٠,٧٨±٠,٣, ٠,٦٩±٠,٣, ٠,٥٩±٠,٥ respectively). Tei index was correlated to the left ventricular ejection fraction (LVEF), left ventricular fractional shortening(LVFS), mitral E/A ratio, heart rate(HR), LVMI and RWT.

CONCLUSION:

The Tei index are impaired in all subgroups of hypertensive patients according to their LV geometry compared to control group. This impairment is more advanced in patients with concentric and eccentric hypertrophy.

KEYWORDS: tei index, hypertension, left ventricular geometry, echocardiography.

INTRODUCTION:

Tei index

Myocardial performance index(MPI) or Tei index (TI) was first described by Tei and colleagues in ١٩٩٥ as "simple and reproducible Doppler index of combined systolic and diastolic myocardial performance". Tei is defined as the sum of isovolumic contraction and relaxation times divided by the ejection time[١]. Tei index is pointed to be more effective in the evaluation of global cardiac functions compared to systolic and diastolic measurements alone. Systolic dysfunction is associated with a prolongation of IVCT and a shortening of ET (ejection time). Diastolic dysfunction often leads to lengthening of IVRT thus both systolic and diastolic dysfunction will result in increase in Tei the reported normal range for Tei index is ٠,٣٩ ± ٠,٠٥ values greater than ٠,٥ are considered abnormal[٢].

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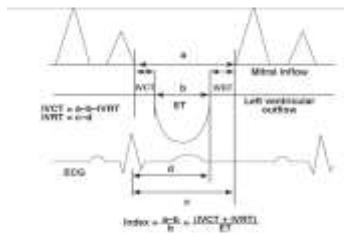

Fig ١:Schematic drawing of the measurement of the Tei index. a:time interval from the end to the start of transmitral flow,b:left ventricular ejection time(ET) ,c:time interval from the peak of the R wave on the ECG to the start of transmitral flow, d:time interval from the peak of the R wave on the ECG to the end of ejection time, IVCT: isovolumic contraction time, IVRT: isovolumic relaxation time(٣).

The combination of left ventricular mass index (LVMI) and relative wall thickness (RWT) values were used to define four geometric patterns as follows[٤-٥] ;

١ –Concentric remodeling: increased RWT but normal LVMI .

٢-Concentric LVH: increased in both RWT and LVMI .

٣-Eccentric hypertrophy: normal RWT and increased LVMI .

٤ -Normal geometry**:** composed of both normal RWT and LVMI .

PATIENTS AND METHODS:

PATIENTS:

This study was conducted at Baghdad Medical City / Teaching Hospital and Alshahed Mohammed B. Alhakem Hospital in Alshulla city . The patients and controls were examined over the period between first January to thirty June ٢٠١٢. ١٢٢ hypertensive patients, their mean age was ٥٦,١٦±٩,٨ years. The study population consist of ٦٦ hypertensive female patients and ٥٦ hypertensive male patients. . In addition sixty seven (٦٧) age-matched non hypertensive subjects served as control group (Group C). The exclusion criteria were as follows: the presence of malignant hypertension; heart failure; cardiomyopathy; or valvopathy; the coexistence of diabetes mellitus (fasting blood glucose >٦,٦ mmol/L or obesity (body mass index >٣٠ Kg/m٢); atrial fibrillation; a history of renal and connective tissue disease; or serum creatinine > ١,٢ mg /dl

METHODS:

M-mode, two-dimensional and spectral Doppler echocardiography were obtained by using (a commercial instrument with ٢,٥-٣,٥ MHz transducer ,En Visor /٢٠٠٥ ٢B type, USA made, supplied by Philips company). The examination were performed for each subject in this study in a dimly light room while they were at rest and sinus rhythm in partial left lateral decubitus position. The measurements were recorded according to the standards recommended by the American society of echocardiography.

RESULTS:

Table ١ demonstrate more percentage for female than male hypertensives.Systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings were higher in the hypertensives with concentric hypertrophy and eccentric hypertrophy than in the control group . LVM and LVMI were increased in patients with concentric hypertrophy and eccentric hypertrophy in comparison to control group.

Variable	Control (C)	Normal geometry	Concentric hypertrophy	Eccentric hypertrophy	Concentric remodeling	NG vs. C	CH vs. C	EH vs. C	CR vs. C

		(NG)	(CH)	(EH)	(CR)	P value	P value	P value	P value
Age(years)	٥٢,٥±٨,٦	٥٣,٤٥±١٠,٠	٥٥,٥±١١,٠	٦٠,٨٣±١١,٣	٥٧,٢٦±١٠,٤	٠,١٤٢	٠,١٣٨	٠,١١٠	٠,١٣٠
Male(n)	٣٠(٤٤,٧٪)	٧(٤٣٪)	١٩(٣٠٪)	١٧(٢٦٪)	١٣(٤٤٪)	NS	٠,٠٢	٠,٠٢	NS
Female(n)	٣٧(٥٥,٣٪)	٨(٥٧٪)	٢٣(٧٠٪)	١٩(٧٤٪)	١٦(٥٦٪)				
SBP(mmHg)	١٣٠,٤٨±١٢,٨	١٣٤,٣±٢٤,٢	١٥٣,٨±٢٣,٦	١٥١,٤٥±٢٣,٦٢	١٣٧,٩±٢٥,٩٩	٠,٠٠١	٠,٠٣١	٠,٠٣٦	٠,٠٢
DBP(mmHg)	٨٢,٤٢±١٢,١	٨٠,٠±١٦,٣٩	٩٧,٩±١١,١٥	٩٤,٢٦±١٢,٧٦	٨٦,٥±١٤,١٣	٠,٠٩	٠,٠٠١	٠,٠٠٣	٠,٠٦
LVM(g)	١٦٤,٥±١٠,٠٨	١٦٨,١٩±٩,١٢	٢٧١,٩٦±١٦,٣٢	٢٦٩,٩٠±١٤,٠٥	١٧٠,٧٦±١٢,٢٨	٠,٠٩	٠,٠٠١	٠,٠٠٢	٠,٠٤
LVMI(g/m^{٢})	٩٠,١٠±١٣,٥	٩٢,٩±١٦,٥	١٥١,٨±٤١,٢	١٤٤,٨±٣٧,٦	٩٠,٥±١٢,٥	٠,٠٥	٠,٠٠١	٠,٠٠٢	٠,٣٢

Table ١: Demographic and echocardiographic characteristic of the different LV geometric patterns.

- Continuous variables were expressed as mean ± SD
- P-value less than ٠,٠٥ were considered as statistically significant
- SBP= systolic blood pressure, DBP=Diastolic blood pressure, LVM= Left ventricular mass and LVMI= Left ventricular mass index

Table ٢ shows that LVEF and LVFS were lower among hypertensives with concentric hypertrophy, and eccentric hypertrophy compared to control group also demonstrate a significant decrease in E/A value and increase in the value of A wave in association with the progressive increase in LV mass. Tei index was significantly increased in the hypertensive patients with concentric hypertrophy (٠,٨١±١,١) and eccentric hypertrophy (٠,٧٨±٠,٣) compared to control group(٠,٣٨±٠,٠٦), and being higher in patients with concentric hypertrophy than those with eccentric hypertrophy.

Table ٢: Left ventricular systolic and diastolic function parameters in the different geometric patterns

Variables	Control (C)	Normal Geometry (NG)	Concentric hypertrophy (CH)	Eccentric hypertrophy (EH)	Concentric remodeling (CR)	NG vs. C P value	CH vs. C P value	EH vs. C P value	CR vs. C P value
EF(%)	٦٨,١٢±١٥,٥٦	٦٧,٤٢±١٧,٠٦	٥٧,٧٣±٢٤,٨٦	٥١,٥±١٥,١	٦٩,٨±١٢,٤٢	٠,٠٨	٠,٠٠٢	٠,٠٠١	٠,٠٤
FS(%)	٣٣,٨٧±١٠,١٥	٣٤,٤٨±١٢,٢٠	٣٠,٦٢±٩,٢٠	٢٢,٢١±٩,٤٤	٣٥,١±٨,٨٧	٠,٠٩	٠,٠٣	٠,٠٠٣	٠,٠٢
E-wave(ms)	٦٧,١±١٥,٤	٨٧,٢±١٢,٤	٨٥,٥±٨,٨	٨٣,١±١٤,٤	٨٦,٢±١٢,١	٠,٠٠١	٠,٠٠١	٠,٠٠٢	٠,٠٠١
A-wave(ms)	٥٥,٩±٤٣,٢	٧٨,٢±١١,٢	٩٧,٢±٨,١	٨٧,٢±١٢,٨	٨٣,١±١٥,٨	٠,٠٠٢	<٠,٠٠١	٠,٠٠١	٠,٠٠١
E/A	١,١٨±٠,١٢	١,١١±٠,٩	٠,٨٨±٠,١٤	٠,٩٥±٠,١٤	١,٠٦±٠,٢٣	٠,٠٥	٠,٠٠١	٠,٠٠٤	٠,٠٣
ET(ms)	٣٦٣,٠±٣٧,٢	٢٩٢,٠±٣٣,١	٢٨٩,٠±٦٠,٥	٢٥٢,٠±٨٧,٧	٢٨٤,١±٣٨,٨	٠,٠٣	٠,٠٢	٠,٠٠١	٠,٠١
IVRT(ms)	٧١,٢±١٦,١	٩٥,١±٢٣,٦	٩٨,٧±٢٩,٩	٩٩,٩±٢٨,١	٩٥,٨±٢٣,٩	٠,٠٤٥	٠,٠١	<٠,٠٠١	٠,٠٣
IVCT(ms)	٦٦,٨±١٣,٤	٩٧,١±٣٣,٤	١٠١,٣±٥٤,١	١٠٣,٠±٣٥,٩	٩٢,٨±٣٧,٣	٠,٠٠٣	<٠,٠٠١	<٠,٠٠١	٠,٠١
Tei index	٠,٣٨±٠,٠٦	٠,٥٩±٠,٥	٠,٨١±٠,٩	٠,٧٨±٠,٣	٠,٦٩±٠,٣	٠,٠٣	<٠,٠٠١	٠,٠٠١	٠,٠٠٤

- Values were expressed as mean ±SD
- P-values less than ٠,٠٥ were considered as statistically significant
- EF=Ejection fraction, FS= Fractional shortening,E/A= transmitral flow ratio, ET=Ejection time, IVRT=Isovolumic relaxation time and IVCT =Isovolumic contraction time.

Figures ٢-٣ demonstrate the Tie index have statistically significant positive linear correlation with each of left ventricular mass index (LVMI) (r = ٠,٣٤٣, p = ٠,٠٠٢), relative wall thickness(RWT) (r = ٠,٤٦٥, p = ٠,٠٠٠١), While figure ٤-٥ show that

Tei index has statistically significant negative linear correlation with each of ejection fraction(EF) (r = -٠,٤٧٧, p = ٠,٠٠٠١) and transmitral E/A flow ratio (r = -٠,٤٥٠, p = ٠.i٠٠٠١).

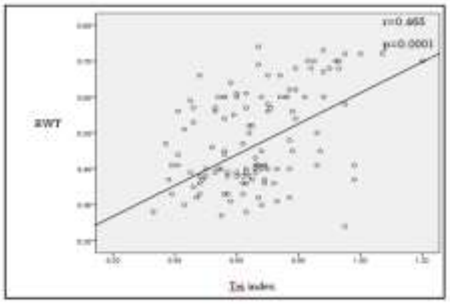

Fig ٢: correlation between Tei index and LVMI

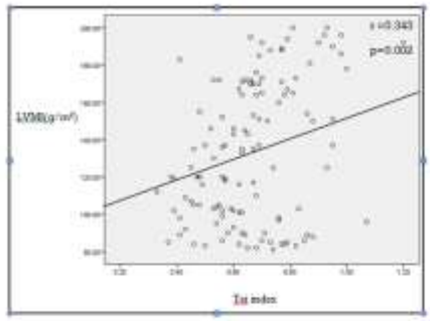

Fig ٣: correlation between Tei index and RWT

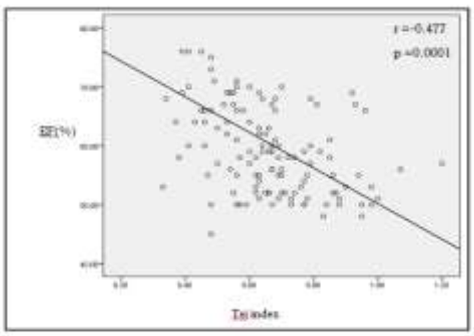

Fig ٤: Correlation between Tei index and EF

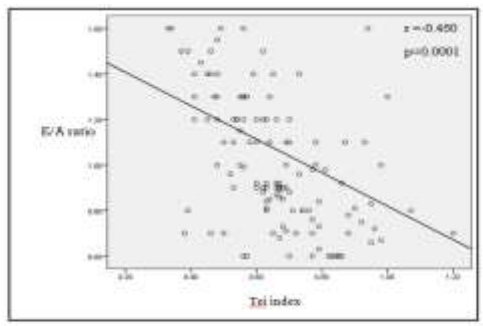

Fig ٥: Correlation between Tei index and E/A

DISCUSSION:

This study revealed that the Tei index was correlated significantly with indices of LV geometry such as LVMI and RWT being highest among hypertensive patients with concentric hypertrophy, closely followed by those with eccentric hypertrophy and then concentric remodeling.

LVEF, LVFS and mitral E/A flow ratio were the main echocardiographic parameters correlated significantly with Tei index. In agreement with our study, Akintuda, et al [٦], reported that Tei index was related to LV ejection fraction, LV shortening fraction and mitral valve E/A flow ratio.

conversely, they reported that there was no relationship between Tei index and LV geometry. On contrast, Masugata, et al [٧], reported that left ventricular EF and left ventricular mass index were not associated with TI, while Yilmaz, et al [٨], reported that TI was associated with the indices of LV geometry (LV mass index and relative wall thickness). In contrast with our study Karaye, et al [٩], reported that LVEF, LVFS and mitral valve E/A flow ratio all correlated insignificantly with Tei index.

Left ventricular systolic function namely ejection fraction and shortening fraction were significantly lower in hypertensives with concentric and eccentric hypertrophy as compared with control group. Similarly transmitral E/A flow ratio was significantly decrease in hypertensives with concentric and eccentric hypertrophy than in control group in agreement with the study results of Adamu, et al [١٠].

LVM, LVMI and RWT was increased with increasing blood pressure among the hypertensives in agreement with similar previous studies of Cuspidic, et al [١١]. Wang, et al and Sega, et al [١٢،١٣].

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