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Original Research Article

Study of Minor Echocardiographic Indices of Cardiac Systolic Function in Subjects with Normal Ejection Fraction and Correlation with Age

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Abstract

Many echocardiographic parameters should be added to traditional cardiac examination beside the EF (ejection fraction) as some conditions are with subclinical systolic dysfunction in spite of normal EF.

To study the minor echocardiographic cardiac systolic function indices in subjects with normal ejection fraction and correlation with age.

Sixty five healthy subjects with normal resting ejection fraction were involved in this study. They were divided into two age groups, group1: 40 subjects with age range (20-39) year and group2: 25 subjects with age range (40-60) year. Measurement of stroke volume index, pre ejection period, left ventricular ejection time and pre ejection period / ventricular ejection time ratio were done.

There were no significant difference of stroke volume index, pre ejection period, ventricular ejection time , and pre ejection period / ventricular ejection time ratio of the two age groups. Correlation study between stroke volume index and ventricular ejection time show significant positive correlation ($r=0.5478$, $p<0.05$) and negative correlation with pre ejection period but statistically nonsignificant ($r=-0.0111$,$p>0.05$) . Correlation study between stroke volume index and pre ejection period / ventricular ejection time ratio was negative correlation but statistically nonsignificant ($r= -0.2139$,$p>0.05$).

Minor echocardiographic indices of cardiac systolic function (systolic time periods) during routine echocardiographic examination are effortless and informative and not affected by aging and should be added to traditional cardiac examination beside the ejection fraction as some conditions are with subclinical systolic dysfunction in spite of normal EF.

Key Words: Ejection fraction, systolic dysfunction, left ventricular ejection time, stroke volume, pre ejection period.

الخلاصة

ينبغي أن يتم اضافة الكثير من المعايير القلبية المقاسة بواسطة ايكو القلب بجانب الجزء المقذوف ،حيث يوجد بعض الحالات من ضعف عمل القلب الانقباضي على الرغم من كون الجزء المقذوف من القل ب طبيعي. الهدف من البحث هو دراسة العلاقة بين مختلف المعايير القلبيه المقاسة بواسطة ايكو القلب وتأثير العمر على هذه المعايير.

اشتملت الدراسة على خمسة وستين شخصا سليما . تم تقسيمهم إلى فئتين عمريتين، المجموعه الاولى تضمنت ٤٠ شخصا مع الفئة العمرية (٢٠-٣٩) سنة، و ٢٥ شخصا مع الفئة العمرية (٤٠-٦٠) سنة. وقد أجري قياس معامل الحجم المقذوف ، فترة ما قبل الانقباضة ، وقت الانقباضة للبطين الايسر ونسبة وقت الانقباضة للبطين الايسر / فترة ما قبل الانقباضة. لم يكن هناك اختلاف كبير ف ي معامل الحجم المقذوف، فترة ما قبل الانقباضة ، وقت الانقباضة للب طين الايسر ونسبة وقت الانقباضة للبطين الايسر / فترة ما قبل الانقباضة بين المجموعتين. ادخال معايير عمل القلب الانقباضي بواسطة ايكو القلب ذات فائدة في عملية التشخيص وليست ذات جهد يذكر .

الكلمات المفتاحية : الجزء المقذوف، عدم كفائة القلب الانقباضية، وقت الانقباضة للبطين الايسر ، الحجم المقذوف، فترة ما قبل الانقباضة .

Introduction

The importance of systolic function evaluation is becoming more and more clear. Parameters of systolic function indices such as stroke volume and ejection fraction are very useful in diagnosis, response to treatment and in prognosis [1]. Never the less , all of these indices have their limitations, especially in the presence of mild systolic dysfunction. Heart failure remains a life threatening condition despite the advances in management of this disease. Hogg et al. in 2004 found that a substantial portion of patients with heart failure had been reported with normal ejection fraction [2]. Other diseased condition ,(e.g.) aortic stenosis, it remains unclear which echocardiographic measure is most suitable for serial measurement in real world aortic stenosis follow up [3].Thereby, other crucial parameters should be added to routine echocardiographic examination other than EF.

Stroke volume can be measured using the product of the integral of aortic velocity obtained by continuous wave Doppler technique and the diameter of the outflow tract .So $SV=0.785\ (D)^2 *VTI$ [4]. The major source of error in stroke volume calculations is due to the inaccuracy of the diameter. The diameter tends to be the smallest measurement and if the measurement is in error, it will have a major impact on calculations based upon its value. Other indices that reflect the systolic function of the heart are systolic time intervals: pre ejection period (PEP) and left ventricular ejection time (LVET). Prolongation of Pre ejection periods and shortening Left ventricular ejection time is the principle abnormality in systolic heart failure patient [5]. PEP/ET ratio is a surrogate of left ventricular dysfunction and shown in earlier study to be useful as predictor for cardiovascular mortality in hemodialysis patients [6].

It seems it is important point to study the effect of age on these parameters.

Materials and Methods

Sixty five healthy men without any cardiovascular, respiratory or metabolic disorders were involved in our research at Shaheed Al-Meherab center. The study was conducted from November 2016 to February 2017. The participants were arranged into two age groups, group1: 40 subjects with age range (20-39) year and group 2: 25 subjects with age range (40-60) year. The experimental protocol was carefully explained and the informed consent was obtained from each person. The experimental protocol was approved by the local ethical committee and all persons gave their informed consent prior to their inclusion in the study. Anthropometric measures, including height, body weight. Exclusion criteria includes: age less than 20 years and more than 60 years ,cardiac risk factors, such as ischaemic heart disease, valvular heart disease, arrhythmias (also heart rate above 100 bpm and less than 60 bpm were excluded), hypertension, diabetes mellitus, hyperlipidemia and smoking, those with ejection fraction less than 55%. Echocardiographic studies included two-dimensional transthoracic and Doppler studies with a clinical GE-Medical Systems XDclear E9 USA 2014 ultrasound machine equipped with 2.5 MHz multi-frequency array transducer. Applying Pulsed wave Doppler of the left ventricular outflow tract (LVOT) by the apical 5 chambers view ,the velocity time integral (VTI) of aortic flow was measured. Outflow tract diameter was measured in the parasternal long axis view [7].

$SV=0.785\ (D)^2 *VTI$ [4]

Indexing the SV is made by dividing it on body surface area to yield stroke volume index.

By these pulsed wave Doppler studies of aortic flow, PEP was measured from the Q-wave of the ECG to the commencement of opening of aortic valve [7].LVET was measured as the time between opening and closure of aortic valve.
Ratio of PEP/LVET was measured.

Statistical Analysis:
all values are expressed as mean ± SD. Independent students T-Test was used for comparison between different means. Pearson's Correlation study was made between SVI and PEP/LVET. P value <0.05 considered statistically significant.

Results:
All parameters were expressed as mean ± SD in table.1.

Table 1: Echocardiographic systolic parameters (expressed as mean±SD)

parameters	SVI(ml.m2/beat)	PEP(mSec)	LVET(mSec)	PEP/LVET
Group1	32.35±6.85	73.11±17.22	301.5±28.14	.241±.059
Group2	33.52±8.13	76±23.52	306.72±9.85	.247±.077

There was no significant difference of SVI, PEP, LVET and PEP/LVET of the two age groups (p>0.05), figure.1. Correlation study between SVI and LVET show significant positive correlation (r=0.5478, p<0.05) and negative correlation with PEP but statistically nonsignificant (r=-0.0111, p>0.05), figure. 2,3 respectively. Correlation study between SVI and PEP/LVET ratio was negative correlation but statistically nonsignificant (r= -0.2139, p>0.05), figure.4.

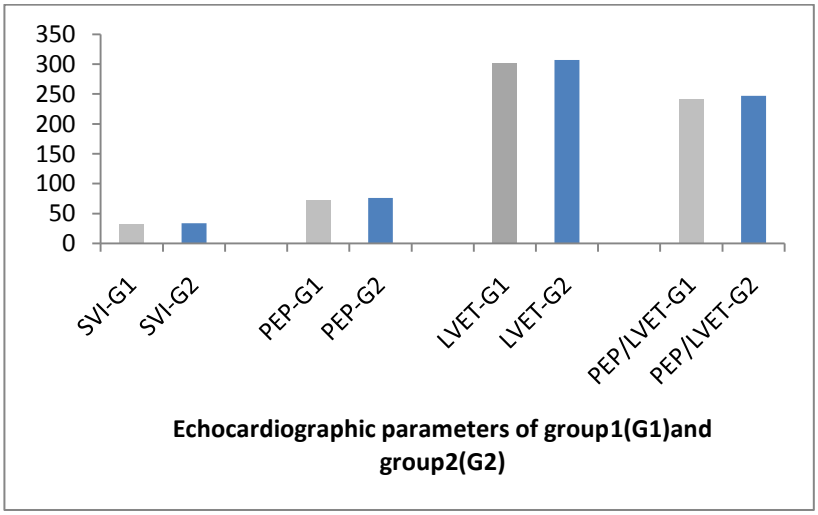

Figure 1: Comparison between echocardiographic parameters of the two age groups. SVI: stroke volume index, PEP: pre ejection period, LVET: left ventricular ejection time.

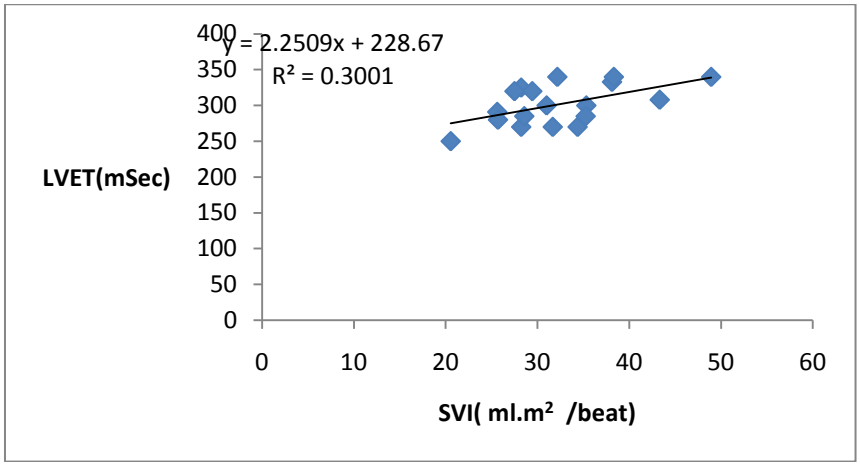

Figure 2: Correlation study between SVI (stroke volume index) and LVET(left ventricular ejection time). $p<0.05$

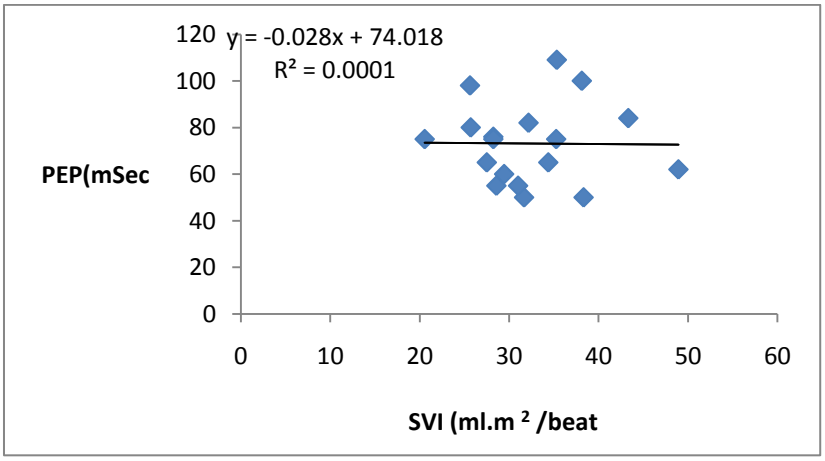

Figure 3: Correlation study between SVI (stroke volume index) and PEP (pre ejection period) .

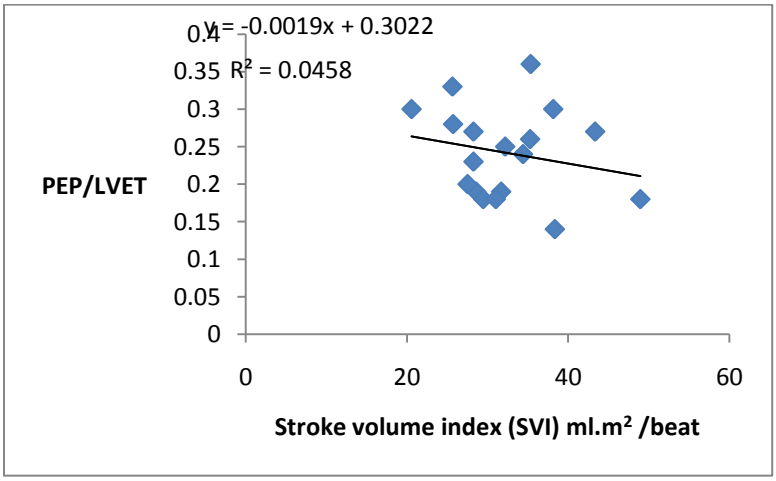

Figure 4: Correlation study between SVI and PEP/LVET ratio.

Discussion

This study showed that SVI were the same for both groups**,** and this goes with other studies that found SVI did not decrease with age [8,9] .These findings are opposed to the early studies which indicated a drop of cardiac function with aging at rest and with exercise [10]. This study showed no significant differences of the all measured systolic time intervals between the two age groups and this is in agree with other studies which stated that LV systolic function at rest appears to be unaffected by aging [11]. As the cardiovascular system at rest functions at only a fraction of its capacity, studies at

rest do not adequately characterize this system or its regulatory mechanisms, subtle signs of age associated differences in cardiovascular function between younger and older individuals become manifest during stress e.g. during exercise [12].

Regarding PEP/LVET ratio, as we mentioned that there was no significant difference between the two groups and this coincide with other studies like Watanabe et al study [1], but disagree with cybulishki et al who found that this ratio decreased with aging[13].

Positive correlation between SVI and LVET is self-explanatory and goes with finding of other studies [14]. Slight prolongation of PEP value in old age group may be explained that PEP is positively related to left ventricular pressure rise time and negatively related to contractility [13], as there is significant structural change in the heart like increase left ventricular wall thickness and fibrosis with aging and increase afterload [15], this might explain the slight prolongation. This negative relation to cardiac contractility can explain the negative correlation between SVI with PEP and SVI with PEP/LVET ratio. Zuber et al. concluded that PEP/LVET ratio negatively correlates with ejection fraction and contractility [16], and their finding can strength our finding about the negative correlation between SVI and PEP/LVET ratio as SVI positively correlated with EF and contractility.

Conclusion

Measurement of systolic time periods during routine echocardiographic examination are effortless and informative and not affected by aging. These minor echocardiographic parameters should be added to traditional cardiac examination beside the ejection fraction as some conditions are with subclinical systolic dysfunction in spite of normal EF.

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