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Echocardiographic Assessment of Left Ventricular Systolic Function in Lymphoma Patient After Initial Dose of Chemotherapy in Baghdad Teaching Hospital

Dr. Firas Yahya Ibrahim
M.B.Ch B, H.D.Medicine/H.D.Echocardiography
Ministry of health - IRAQ
Salah Aldin department
Balad General Hospital
Salah Aldin, Iraq
Dr.firas.medic@gmail.com
Prof. Hasan Farhan
FICMS"Cardiol",FACC,FRCP,FESC,FEVIC,MSc,DME
Senior Consultant cardiologist and medical educationalist
Baghdad Heart Center
Baghdad, Iraq
Prof. Ali Mohameed Jawad
M.B.Ch.B, CABM.FRCP
Professor of Hematology
College of medicine
University of Baghdad
Baghdad, Iraq

Background: Despite cancer therapeutics-related cardiac dysfunction (CTRCD) can be initially asymptomatic, if not detected and properly managed, it may progress to severe and irreversible heart failure. Therefore, identification of high-risk patients and early detection of subclinical myocardial dysfunction are fundamental tasks for the management of cancer patients undergoing chemotherapy, involving both cardiologists and oncologists. LVEF has low sensitivity for the detection of small changes in LV function. LVEF calculated by conventional 2DE often fails to detect small changes in LV contractility because of several factors. These factors include LV geometric assumptions, inadequate visualization of the true LV apex, lack of consideration of subtle regional wall motion abnormalities, and inherent variability of the measurement**.** Accordingly, strategies using newer echocardiographic technology, such as STE-derived strain imaging for the early detection of subclinical LV systolic dysfunction. GLS being the most robust and reproducible among the myocardial strain parameters, this parameter has raised the interest of the investigators to detect early and subclinical myocardial dysfunction in patients at risk of CTCRD

Objective: Study the role of GLS in early detection of LV systolic dysfunction and comparison the agreement of LV GLS with other conventional echocardiographic parameters (MAPSE, S') for detection of early subclinical LV systolic dysfunction after initial dose of chemotherapy in lymphoma patients.

Patients and methods: All patients were included in this study diagnosed as lymphoma without overt risk factors of LV dysfunction. All patients undergoing echocardiographic examination involved LVEF, MAPSE, tissue Doppler systolic S' velocity and GLS was done before and after initial dose of chemotherapy (anthracyclines).

Result :The total number was 67 patients, the mean age of studied patients was 38.19±11.66 years and 49.3% of patients were males. According to the statistical analysis of data was observed that the diagnosis

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of subclinical LV systolic dysfunction was detected by Global Longitudinal Strain (GLS) in 28(39 %) case in comparison with 17(25%) cases was detected by Doppler tissue peak systolic velocity(S'), KAPPA agreement between the two examination was 0.643, p value=0.001. So tissue Doppler systolic S' velocity can detect LV systolic dysfunction in comparison with GLS as a gold standard test with sensitivity=60.7%, and specificity=100% as seen in table 1.

The subclinical left ventricular systolic dysfunction was detected by Mitral Annular Plane Systolic Excursion (MAPSE) in 19(18%) cases, KAPPA agreement between GLS and MAPSE was 0.518, p value=0.001. as seen in table 2

Table 1: Agreement between GLS and S' in diagnosis of subclinical LV systolic dysfunction after chemotherapy treatment

		GLS)		
		Subclinical	**Normal**	**Total**
S'	**Subclinical**	**17(60.7%)**	**0**	**17**
	Normal	**11(39.3%)**	**39(100%)**	**48**
Total		**28**	**39**	**67**
KAPPA value=0.643, p value=0.001, sensitivity=60.7%,specificity=100%				
S'= Doppler tissue peak systolic velocity, GLS= Global Longitudinal Strain,				

Table 2: Agreement between GLS and MAPSE' in diagnosis of subclinical LV systolic dysfunction after chemotherapy treatment

		GLS)		
		Subclinical	**Normal**	**Total**
MAPSE	**subclinical**	**16(57.1%)**	**3(7.7%)**	**19**
	Normal	**12(42.9%)**	**36(92.3%)**	**48**
Total		**28**	**39**	**67**
KAPPA value=0.518, p value=0.001, sensitivity=57.1%,specificity=92.3%				
GLS= Global Longitudinal Strain, MAPSE= Mitral Annular Plane Systolic Excursion,				

Conclusion :- The gold standard parameter for detection of early subclinical LV systolic dysfunction after initial dose of chemotherapy is GLS, tissue Doppler systolic S' velocity has agreement with GLS with sensitivity= 60.7%60% and specificity = 100% while MAPSE has agreement with GLS with sensitivity=57.1%, and specificity =92.3%.So this study emphasize on use of GLS to detect early subclinical LV systolic dysfunction after chemotherapy, but we can used tissue Doppler systolic S' velocity and MAPSE as a daily practice in echocardiographic laboratory when GLS is not available.,

Aims of the study: -Study the role of GLS in early detection of LV systolic dysfunction and comparison the agreement of LV GLS with other conventional echocardiographic parameters (MAPSE, S') for detection of early subclinical LV systolic dysfunction after initial dose of chemotherapy in lymphoma patients.

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Key Words:- Lymphoma, Echocardiography, LV systolic dysfunction, Chemotherapy.

Introduction

Cardiac dysfunction resulting from exposure to cancer therapeutics was first recognized in the 1960s, with the widespread introduction of anthracyclines into the oncologic therapeutic armamentarium. Heart failure (HF) associated with anthracyclines was then recognized as an important side effect. As a result, physicians learned to limit them doses to avoid cardiac dysfunction. The Cancer Therapeutics–Related Cardiac Dysfunction (CTRCD) have been used historically [4] and was defined as a decrease in the LVEF of >10 percentage points, to a value <53% (normal reference value for two-dimensional echocardiography (2DE) . [1] .There are many different types of cardiotoxicity, including reversible, irreversible, acute, chronic, and late-onset. Irreversible damage is categorized as type 1 and reversible damage as type 2 :-

-**Type 1 (Irreversible damage)** is usually caused by a cumulative dose; chemotherapy drugs that can cause irreversible toxicity include **anthracyclines**; **alkylating agents**; **taxanes**; **topoisomerase inhibito**; and **antimetabolites** . The most common chemotherapy agents associated with type 1 damage are the anthracyclines. Anthracyclines, especially doxorubicin, are used to treat several types of cancer, including breast, gynecologic, sarcoma, and lymphoma.

-**Type 2 (reversible damage)** is not related to a cumulative dose, chemotherapy agents that can cause reversible cardiotoxicity are **trastuzumab, bevacizumab, lapatinib, and sunitinib**. [2]

Echocardiographic Evaluation of Cardiac Structure and Function in Cancer Patients.

Echocardiography is the cornerstone in the cardiac imaging evaluation of patients in preparation for, during, and after cancer therapy, because of its wide availability, easy repeatability, versatility, lack of radiation exposure, and safety in patients with concomitant renal disease.

Left Ventricular Systolic Function.

Changes in LVEF indicative of LV damage can be more appropriately identified when comparisons are made between baseline and follow-up studies. Accordingly, strategies using newer echocardiographic technology, such as STE-derived strain imaging for the early detection of subclinical LV systolic dysfunction, have been actively investigated. [3,4]

Detection of Subclinical LV Dysfunction:

1-LVEF as a Tool to Detect Subclinical LV Dysfunction.

Although the decrease in LVEF during treatment has been associated with symptomatic HF, the ability of serial LVEF assessment during and after treatment to identify CTRCD and prevent subsequent HF remains controversial [4]. A reduced LVEF (including LVEFs of 50%–54%) at baseline or after anthracyclines was associated with higher rates of cardiac events on follow-up, Unfortunately, detecting a decreased LVEF after anthracyclines may be too late for treatment, suggesting that more sensitive parameters of LV dysfunction would be helpful . [5]

2-Detection of Subclinical LV Dysfunction Using DTI Velocities.

Several investigators have demonstrated an early reduction in e' velocity of the mitral annulus in patients receiving anthracyclines which remained reduced during treatment and several years thereafter. [6,7] Annular systolic velocity(s`) is a marker of global left ventricular function in a uniformly contracting ventricle. [8] Doppler tissue peak systolic velocity(S`) normally ≥ 9 cm/sec. [9]

Advantages:- [10]1- Less dependent on 2D imaging quality.
2-Can help in detection of subtle LV longitudinal dysfunction.
3- Less affected by preload & afterload.
4- Less angle dependent.
5- Less time consuming in expert hand.

3- Early Detection of LV Dysfunction Using Strain and Strain Rate.

Myocardial deformation, or strain, imaging is a relatively novel yet promising method for assessment of cardiac function. Strain is defined as a change in length of an object relative to its original length (i.e.,

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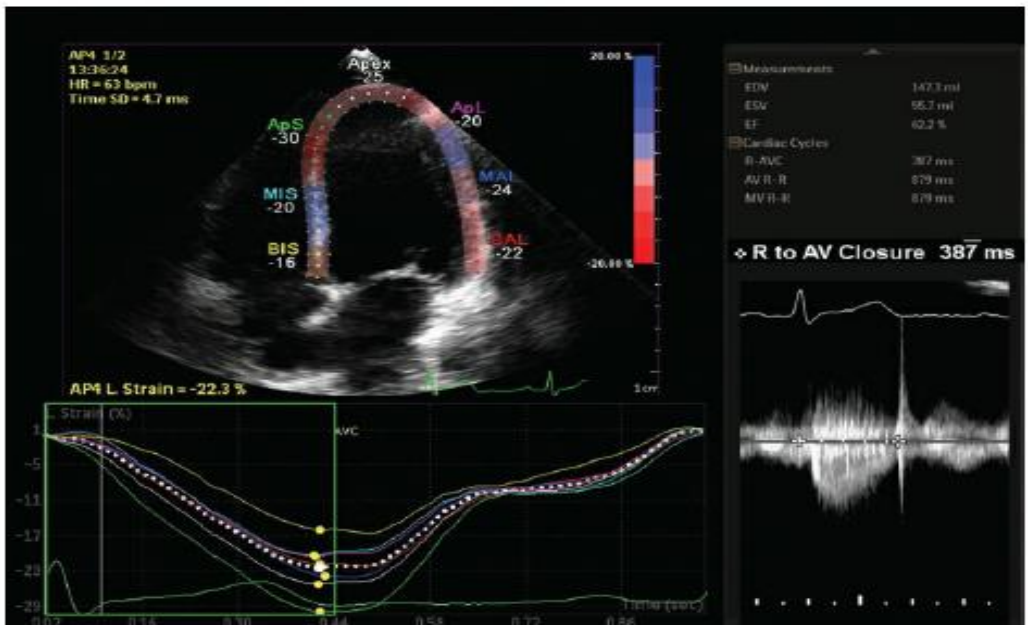
reduction to half its original length is 50% strain**.** Negative strain implies shortening of a segment (contraction) and positive strain lengthening of a segment (relaxation). Normal contraction is defined by negative longitudinal systolic strain followed by biphasic diastolic strain related to early and late diastolic filling, respectively. Normal radial strain, reflecting wall thickening is positive in systole. Strain rate represents the change in velocity between two adjacent points, the typical method by which longitudinal strain is calculated is to acquire an apical four-chamber, two chamber and apical long-axis view of the left ventricle. Each of these views is then subjected to speckle tracking analysis to assess longitudinal strain in discrete segments. Assessment of end-systolic strain requires identification of end-systole. The current recommendation is that timing of end-systole be determined from Doppler of the left ventricular overflow tract and defined as aortic valve closure (Fig. 1-1). [11]



Fig(1-1):Apical four-chamber view from which longitudinal strain has been obtained in seven segments. The image at the upper left is the apical four chamber view. The mid myocardium is noted by the dotted line. Below the apical four-chamber view is a graphic representation of each of the seven segments as well as the global strain for the apical four-chamber view. The vertical line (AVC) denotes end-systole. At the lower right is a Doppler of the left ventricular outflow tract from which the time from onset of QRS to aortic valve closure has been calculated as 387 ms. to define end-systole. At the upper right are the simultaneously obtained volumetric measurements of left ventricular volume from which the ejection fraction is calculated to be 62.2%. [11]

Speckle tracking strain is less load dependent compared with other echocardiographic parameters and allows detection of early LV systolic dysfunction before overt evidence of a fall in ejection fraction. Most often global longitudinal strain (GLS) is measured with images acquired in apical four-chamber, two-chamber, and long-axis views. Longitudinal strain is a negative number with the normal value varying among different ultrasound systems, but typically it is about -18% _-25% . [9]

The current recommendation for global longitudinal strain (GLS) is that it be calculated on an 18-segment model with part of the apex being represented in each of six segments representing the apical third of the left ventricle. Individual strain can be plotted over the cardiac cycle for each segment and GLS calculated as the average longitudinal strain in each of the 18 segments (Fig. 1-2). [8]

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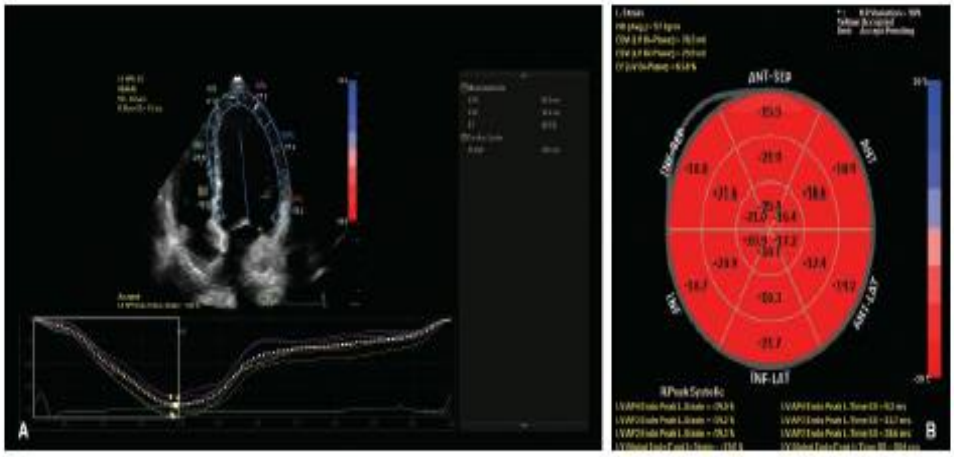

Fig (1-2) A: Apical four-chamber view from which longitudinal strain has been recorded in 18 segments as per the current recommendation. The central figure is the apical four-chamber view with the myocardium automatically tracked by speckle tracking technology. Individual strain data for the visualized six segments as presented in the graph. The table at the upper right presents volumes and ejection fraction. B: Bull's-eye plot of longitudinal strain obtained in the recommended 18 segments recorded in the same patient presented in panel A. [8] The advantages of speckle tracking compared with Doppler tissue velocities are:

(1) Simpler data acquisition.
(2) Lack of angle dependence.
(3) Direct measurement of strain.
(4) Multiple simultaneous measurements in the image plane, and
(5) The ability to perform the analysis after image acquisition. [12]

The decrease in myocardial systolic function induced by anthracyclines appears to be extremely rapid, as early as 2 hours after the first anthracycline dose. The decrease in deformation indices preceded the decrease in LVEF and persisted during the subsequent cancer treatment.

Early decreases in radial and longitudinal strain and strain rate were noted using DTI and STE and have been confirmed in patients treated with anthracyclines (in some studies in association with taxanes and trastuzumab), with or without later decreases in LVEF. Fig(1-3). [13]

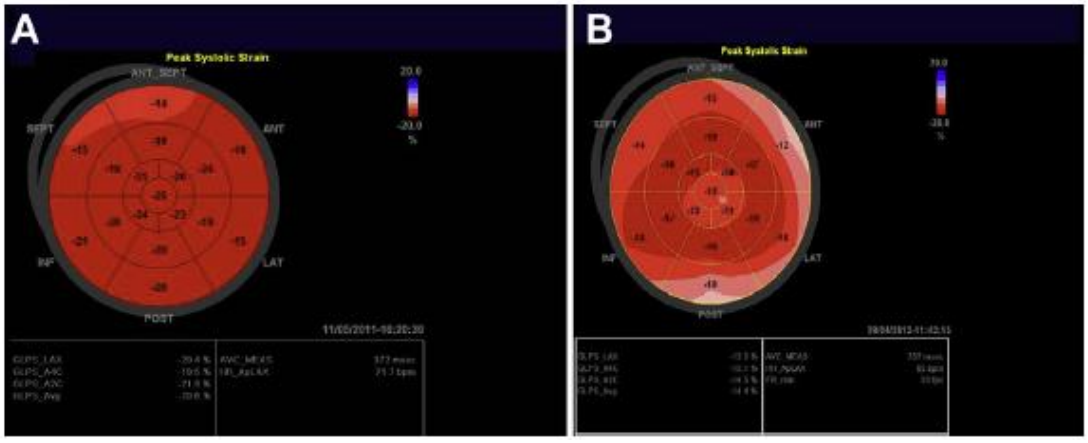

Fig (1-3) Bull's-eye plot showing GLS of the patient. (A) GLS and regional longitudinal strain at baseline. (B) GLS and regional longitudinal strain 3 months during trastuzumab-based therapy after anthracyclines. GLS has decreased from _20.6% to _14.4% (30% decrease). The decrease in GLS is therefore considered of clinical significance (>15% vs baseline) . [13]

So, we can conclude that: -

- Myocardial deformation (strain) can be measured using DTI or 2D STE. The latter is favored because of a lack of angle dependency.

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- GLS is the optimal parameter of deformation for the early detection of subclinical LV dysfunction.
- Ideally, the measurements during chemotherapy should be compared with the baseline value. In patients with available baseline strain measurements, a relative percentage reduction of GLS of <8% from baseline appears not to be meaningful, and those >15% from baseline are very likely to be abnormal. Fig(1-4)
- When applying STE for the longitudinal follow-up of patients with cancer, the same vendor-specific ultrasound machine should be used . [14]

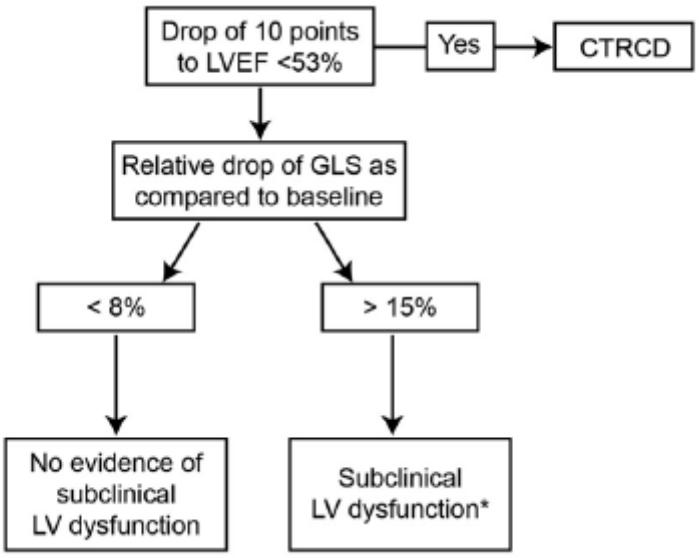

Fig (1-4): Early detection of subclinical LV dysfunction using GLS. In the absence of adjudication of CTRCD, it is recommended to use GLS for the identification of subclinical LV dysfunction. If baseline strain is available, a relative percentage decrease of >15% compared with baseline is likely to be of clinical significance, whereas a decrease of <8% is not. [13]

. Detection of Subclinical LV Dysfunction Using Biomarkers :- Biomarkers have the potential to fulfill a critical unmet need as a robust diagnostic tool for the early identification, assessment, and monitoring of CTRCD. [13,15]Cardiac troponins are the gold-standard biomarkers for the diagnosis of myocardial injury. Troponin I (TnI) is a sensitive and specific marker for myocardial injury in adults treated with anthracycline chemotherapy, and studies suggest that an elevation of troponin identifies patients at risk for the subsequent development of CTRCD . [16]

Patients and methods

Study's design: - This interventional prospective study was conducted in Baghdad Teaching Hospital, Hematological department and echocardiography unit. The study was conducted during the period 1st of June 2019 to 1st June 2020.

Study's sample: - The patients presented with lymphoma (Hodgkin's and non-Hodgkin's) were have: -

1- Normal function in the phase of chemotherapy that was defined by stability of Ejection Fraction ≥54% in female and ≥ 52% in male, measured by Simpson method.
2- Good images high frame rate 2D acquisitions for speckle strain analysis.
3- Normal 2D average global systolic longitudinal strain (GLS) at baseline study (defined as GLS greater or equal to -18%).

Exclusion criteria: - From history, clinical examination, ECG, echocardiography and biochemical investigation the followings were excluded:

1- Hypertension.
2- DM.
3- Ischemic heart disease.
4- Cardiomyopathy
5- Radiation therapy of the chest.

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6- Cardiac arrhythmia.
7- Valvular heart disease.
8- Rheumatic heart disease.
9- Chronic alcohol drinking.
10- Drug (e.g. beta- blockers or calcium-channel blockers)
11- Any patient with impaired EF (< 54% in female and <52% in male).
12- A GLS value of below -18% at baseline visit.

Method and Echocardiography: -

The patients were assessed twice, first assessment was done before starting chemotherapy while the second assessment were done three weeks after initial dose of chemotherapy, these assessments were included LV systolic function using ejection fraction (Simpson's method), global longitudinal strain (GLS), mitral annular systolic velocity (S') and mitral annular planar systolic excursion (MAPSE) in addition to that measurement of serum troponin I.

Transthoracic echocardiography and ECG were performed simultaneously with echocardiographic equipment (General health Vivide E 9) that has TDI capabilities and phased array transducer frequency of 5 MHz Measurements were undertaken in the left lateral decubitus position by the researcher. Echocardiographic examination and measurements are done according to recommendations of American society of echocardiography.

Recordings were taken while the patients held their breath at expiration. The measurements were registered as the mean of the values of three consecutive beats. The examination was performed for each patient involved in this study in a dimly light room using transthoracic echocardiography. For most, echo images were obtained while the patient either supine and/or in the left lateral decubitus position. The examiner seated to the right side of the patient; scanning was performed with the right hand. The transducer was placed on the chest using gel then the images were acquired in the parasternal long axis, parasternal short axis as well as apical four –three and two-chamber views in addition to subcostal view. Images were at the end of expiration except for the subcostal view which has been taken at the end of inspiration. All measurements were taken along with simultaneous electrocardiogram at a speed of 25 mm/s during three consecutive heart cycles, and the mean values were calculated.

Ethical considerations: -

The research proposal was fully discussed and approved by the scientific and ethical committee in Baghdad college of medicine.

The agreement of health authority in medical city was approved before starting data collection.

A written consent was taken from each included patient after full explanation of study and ensuring of confidentially of collected data which will not be used for any purpose other than research.

Statistical analysis: -

The collected date was introduced into Microsoft excel sheet 2016 and loaded into (SPSS) version 26 statistical software program.

Descriptive statistics were presented using tables (frequency and percentage and mean_+ standard deviation) and graphs accordingly.

Chi square test was used to find out association between study categorical variables.

Paired sample t test was used to find out significance difference between mean of continuous numerical variables before and after treatment.

Analysis of covariance (ANCOVA) were used to find out significance of difference between end line measurements after adjustment of baseline measurement according to independent categorical variables.

KAPPA agreement sensitivity and specificity of screen echo graphic test in comparison with gold standard echography test was done.

P value less than 0,05 was considered as discrimination point of significance.

Results

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This interventional study included 67 patients suffered from lymphoma, the mean age of studied patients was 38.19±11.66 years and 49.3% of patients were males. Regarding cardiac troponin I all patients were negative except one case was positive., other initial characteristic as shown in table 3-1.

Table 3-1 Initial base line characteristic of patients

		N	%
Age	**Mean ±SD=38.19 ±11.66 year**		
	=<40	**35**	**52.2%**
	>40	**32**	**47.8%**
Gender	**Male**	**33**	**49.3%**
	Female	**34**	**50.7%**
Malignancy	**Hodgkin**	**32**	**47.8%**
	No Hodgkin	**35**	**52.2%**
Duration	**1 month**	**34**	**50.7%**
	2 months	**33**	**49.3%**

According to the statistical analysis of data was observed that the diagnosis of subclinical LV systolic dysfunction was detected by Global Longitudinal Strain (GLS) in 28 cases in comparison with 17 cases was detected by Doppler tissue peak systolic velocity(S'), KAPPA agreement between the two examination was 0.643, p value=0.001.So S' can detect LV systolic dysfunction in comparison with GLS as a gold standard test with sensitivity=60.7%, and specificity=100%.as seen in table 3-2.

Table 3-2 Agreement between GLS and S' in diagnosis of subclinical LV systolic dysfunction after chemotherapy treatment

		GLS)		Total
		Subclinical	**Normal**	
S'	**Subclinical**	**17(60.7%)**	**0**	**17**
	Normal	**11(39.3%)**	**39(100%)**	**48**
Total		**28**	**39**	**67**
KAPPA value=0.643, p value=0.001, sensitivity=60.7%, specificity=100%				
S'= Doppler tissue peak systolic velocity, GLS= Global Longitudinal Strain,				

The subclinical left ventricular systolic dysfunction was detected by Mitral Annular Plane Systolic Excursion (MAPSE) in 19 cases,KAPPA agreement between GLS and MAPSE was 0.518, p value=0.001. MAPSE can detect LV systolic dysfunction in comparison with GLS as a gold standard test with sensitivity=57.1%, and specificity=92.3%. as seen in table 3-3.

Table 3-3 Agreement between GLS and MAPSE' in diagnosis of subclinical LV systolic dysfunction after chemotherapy treatment

		GLS)		Total
		Subclinical	**Normal**	
MAPSE	**subclinical**	**16(57.1%)**	**3(7.7%)**	**19**
	Normal	**12(42.9%)**	**36(92.3%)**	**48**

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Total	**28**	**39**	**67**
KAPPA value=0.518, p value=0.001, sensitivity=57.1%, specificity=92.3%			
GLS= Global Longitudinal Strain, MAPSE= Mitral Annular Plane Systolic Excursion.			

The significant association was observed between delay onset of chemotherapy ≥ 2 months and development of subclinical LV systolic dysfunction, P value= 0.001, RR=0.324, 95%CI=0.159-0.657, otherwise age group, gender or types of malignancy show no significant association with subclinical LV systolic dysfunction as seen in table 3-4.

Table 3-4 Analysis of studied variables as predictor for subclinical of LV systolic dysfunction

		Global Longitudinal Strain (GLS).				
		Subclinical LV systolic dysfunction.		Normal		
		Count	Row N %	Count	Row N %	
Age	**=<40**	**17**	**48.6%**	**18**	**51.4%**	**0,239**
	>40	**11**	**34.4%**	**21**	**65.6%**	
gender	**Male**	**11**	**33.3%**	**22**	**66.7%**	**0,167**
	Female	**17**	**50.0%**	**17**	**50.0%**	
malignancy	**Hodgkin**	**15**	**46.9%**	**17**	**53.1%**	**0,420**
	No Hodgkin	**13**	**37.1%**	**22**	**62.9%**	
duration	**1 month**	**7**	**20.6%**	**27**	**79.4%**	***0,001**
	≥2 months	**21**	**63.6%**	**12**	**36.4%**	
***RR=0.324, 95%CI=0.159-0.657**						

The result of echocardiographic parameters of studied patients pointed that 22(79%) patients had no treatment modification and 6(21%) patients got treatment modification, as shown in figure 3-1

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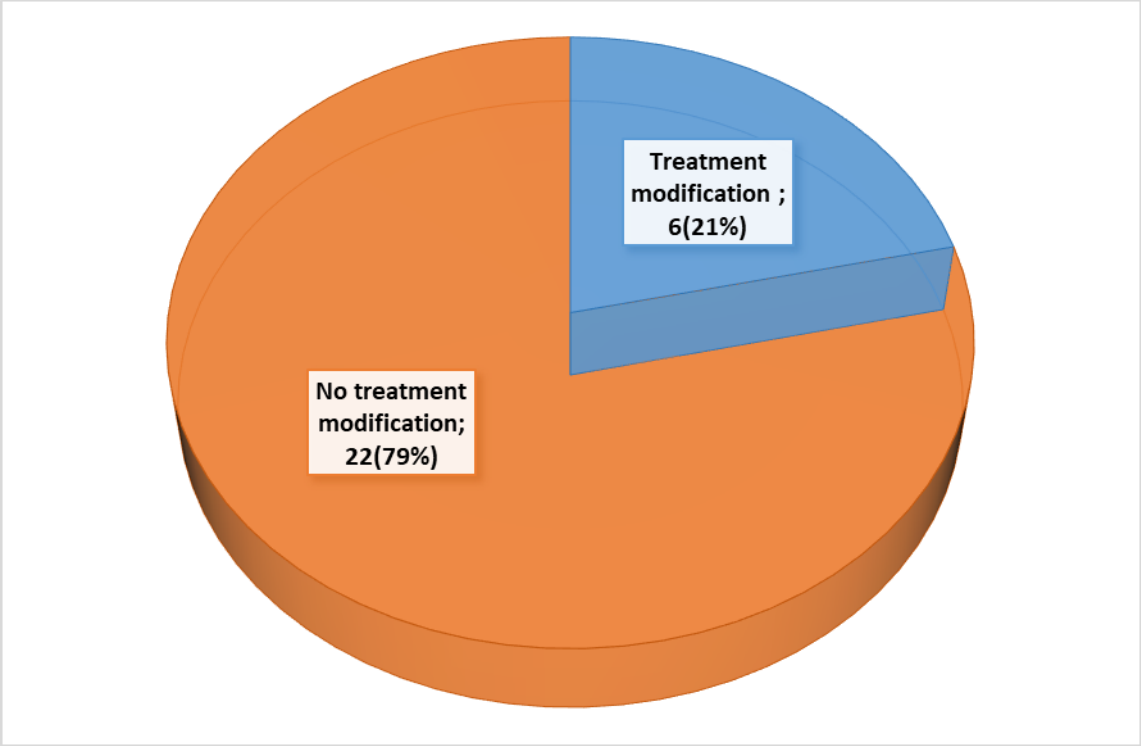

Figure: 3-1 Treatment modification among patients proved to have subclinical LV dysfunction according to the decision opinion.

Discussion

Cancer therapeutics-related cardiac dysfunction (CTRCD) has become a leading cause of high rate of morbidity and mortality for cancer survivors after two years. Thus, there has been a growing interest in early detection of CTRCD by means of global longitudinal strain (GLS) assessed by two-dimensional speckle-tracking echocardiography. [17]

In our study the result reveals that end line readings of all studied echocardiographic parameters in patients who were started treatment after two months from onset symptoms were have more significant reduction than that of patients started treatment after one month from onset symptoms, this result explain the impact of time of initiation of chemotherapy on clinical outcome of patient with lymphoma. This finding also explained by (**Edward G. Brooks**. et al. **study**) [18] which concluded that clinicians should make every effort possible to initiate curative-intent chemotherapy as soon as a diagnosis of lymphoma is established.

There is significant reduction in GLS was observed after receiving first dose of chemotherapy which is the same observations reported by previous study (**Yali . et al. study) [19]** that reveals early reduction in GLS of patients with lymphoma after receiving chemotherapy**.** Our study thereby confirms that longitudinal strain variables indicate subtle myocardial changes and precede a noticeable decrease in LVEF in adult patients with lymphoma after chemotherapy. Hence, myocardial strain imaging is more sensitive method than the currently conventional measure of LV systolic function (LVEF) for the early detection and monitoring of LV systolic function following anthracycline chemotherapy.

MAPSE is one of the parameters used to measure LV systolic function. In the current study MAPSE has benefit in detection of subclinical LV systolic dysfunction of patients on chemotherapy. this result is consistent with **(Sadeq IA. et al. study)** [20] **(Joanna Luszczak. et al. study).** [21] that reported mitral annular plane systolic excursion can be used as a sensitive tool to detect early LV systolic dysfunction.

The tissue Doppler parameter (S') showed that significantly differences for patients before chemotherapy compared with the result after anthracyclines chemotherapy. This finding is similar to the results of previous **studies** (**Sadeq IA . et al. study) [20] and (JACOPO OLIVIERI. et al. study)** [22]. **(Ines Monte. et al. study)**

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[23] and **(Lotrionte M. et al. study)** [24] revealed that using Eco-TDI in patients treated with anthracyclines showed early alterations of longitudinal left ventricular contractile function, in absence of changes in LVEF, detected earlier than changes in ejection fraction.

In our study shows that the most sensitive and specific parameter to detect LV systolic dysfunction is the GLS followed by mitral annular peak systolic velocity (S') then MAPSE , these data correlate with studies (**Sadeq IA. et al.study**) [20] and (**JACOPO OLIVIERI. et al. study) [22],** that states the most sensitive parameter for detection of subclinical systolic dysfunction of patient on chemotherapy is GLS, followed by S` then MAPSE and all is more sensitive and specific than EF which is similar to our findings .This point can highlight the importance of doing GLS for patients with cancer receiving chemotherapy to detect early subclinical LV systolic dysfunction, if not available we can depend on S', MAPSE instead of using only LVEF in order to early detection of subclinical LV systolic dysfunction which may need precise optimization of drug therapy that can lead to delay or prevention of further worsen of LV systolic function and might end with better outcome.

From all patients with subclinical LV systolic dysfunction, (21%) patients had modified their treatment regimen by their hematologist because of adverse effects of original regiments of treatment on heart function, diagnosed by echo examination (GLS). This result support additive of cardioprotective drug that similar to the (**S. Limat . et al. study**) [25] and **SUCCOUR** study (Strain surveillance during chemotherapy for Improving Cardiovascular outcomes (SUCCOUR)) state that the patients with a relative reduction of GLS by ≥12% are treated with cardioprotective therapy. [26]

Limitations of the study: -

1. Subclinical or silent coronary artery disease cannot be excluded in patients without performing coronary angiography.
2- The study done in a single center.

Conclusion

1- Using new echocardiographic modality STE (speckle tracking echocardiography) (GLS), TDI and MAPSE are more accurate methods to detect early subclinical LV systolic dysfunction after initial dose of chemotherapy on lymphoma patients than the conventional method (LVEF) echocardiography.

2-The gold standard parameter for detection of early subclinical LV systolic dysfunction after initial dose of chemotherapy is GLS, TDI has agreement with GLS with sensitivity= (60.7%) and specificity =(100%) while MAPSE has agreement with GLS with sensitivity=(57.1%), and specificity =(92.3%).So the finding of current study emphasize on use of GLS to detect early subclinical LV systolic dysfunction after chemotherapy, but we can used alternatively DTI and MAPSE in daily practice echo examination when GLS is not available.

Recommendation

1-Early detection of subclinical LV systolic dysfunction in patient with lymphoma on chemotherapy by using GLS, TDI and MAPSE (both at baseline and after initial dose of chemotherapy) lead to more precise and optimal management after proper evaluation by cardiologist and hematologist.

2- In the absence of speckle tracking imaging, we should use peak systolic velocity (S') of the mitral annulus by pulsed-wave DTI and /or mitral annular displacement by M-mode echocardiography for the assessment of LV systolic function instead of LVEF in patients treated with chemotherapy.

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