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A COMPARATIVE STUDY OF DETECTION OF ALTERATION OF LEFT VENTRICULAR STRAIN BY SPECKLE TRACKING ECHOCARDIOGRAPHY IN ADULT PATIENTS WITH RHEUMATIC MITRAL STENOSIS

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ABSTRACT

Heart valve disorders (HFD) continue to be a health concern. About 13.3 million people in Europe have VHD, with aortic stenosis and mitral regurgitation being the most common forms. About 2.5% of Americans had valvular heart disease, a condition that was more common in older people. Heart failure, particularly moderate and severe heart failure, which was detected in 14% of individuals with suspected heart failure, is known to be associated with VHD. The clinical symptoms and evidence of impaired heart function serve as the foundation for the management of VHD. for Assessing the valve and identifying cardiac dysfunction require imaging testing.With its broad availability, echo cardiograph is a highly valuable diagnostic tool for assessing heart function in individuals suspected of having valvular disease.In addition, the assessment of left ventricular ejection fraction (LVEF) can be a crucial marker for determining if an invasive management approach is necessary for the evaluation of cardiac function. Even if the ejection fraction remains normal, there may already be a disturbance in myocardial function. It's possible that the myocardial damage is irreversible if the LVEF is already compromised. Therefore, to avoid additional harm to the myocardial structure, an assessment to identify early cardiac dysfunction prior to LVEF impairment may be necessary.Because global longitudinal strain (GLS) can identify sub-clinical myocardial failure, it is a better metric than left ventricular ejection fraction (LVEF). GLS is helpful in assessing mild heart impairment and has good feasibility as well. The main idea behind strain imaging and its relationship to myocardial deformation-an indication known as strain is expressed as a percentage and provides information about any deviation in a segment's length from the baseline measurement. There are three strains in cardiac tissue because it is a three-dimensional thing. Myocardial deformation is presented in the strain analysis, which is correlated with stroke volume. Three shear strains—longitudinal–radial, longitudinal–circumferential, and circumferential–radial—as well as three normal strains—longitudinal, circumferential, and radial—affect the left ventricle's deformation.The mitral valve contracts, causing longitudinal strain, which is represented as negative strain, from the base to the apex.

The left ventricular (LV) wall's relative thickening is reflected by the radial strain, which is displayed as a positive strain value. Finally, circumferential strain, which is shown as a negative value, illustrates the cardiac tissue's anticlockwise migration from base to apex. Thickness is defined by positive strain, and

shortness is defined by negative strain values. The measurement of strain is influenced by a few variables, including loading, preload, and after load modification. LV geometry may change in patients with VHD because to variations in LV load. Because of inadequate screening paradigms and tertiary techniques, sub-clinical cardiac dysfunction frequently remains un diagnosed, precluding the development of heart failure and other cardiovascular illnesses.Early diagnosis and identification of the physiological alterations that precede the development of clinical heart disease benefits patients with sub-clinical cardiac dysfunction by allowing for prompt intervention and prevention. Prolonged inflammation and fibrosis resulting from rheumatic inflammation can lead to a decline in left ventricular function that may not be apparent using standard echo cardiograph. Variables impacting strain measurements in VHD: The strain measurement could be affected by a number of variables, including tissue properties, load, and structure (geometry). Loading factors: Different modifications to preload and after load may have distinct effects on cardiac deformation. Myocardial strain would rise with an increase in preload and fall with an increase in after load. An observational research looked at how an abruptly reduced preload affected strain. The GLS measurement decreased by 25% when the individuals were angled to lessen the preload. The strain measurement would first rise as a result of normal function before falling as a result of ventricular failure. A study by Burns et al. similarly demonstrated an increase in the systolic strain following sublingual delivery of glyceryl trinitrate. Despite the fact that both after load and preload were reduced, this study focused on the role of after load reduction as the primary determinant. In patients with aortic stenosis, a higher after load also resulted in a reduction in longitudinal strain.The process by which strain and chamber pressure can be converted into wall stress and volume alteration, respectively, is influenced by the geometry of the ventricle. Overloading the heart with pressure might cause cardiac remodeling in patients with VHD. As a result, the walls will get thicker and the chamber will get smaller. Thirteen The purpose of these modifications is to preserve heart function (measured by ejection fraction) in the face of declining values for longitudinal and circumferential strain. One of the many factors used to assess cardiac function is LVEF, which is also suggested by guidelines when deciding how best to treat valvular heart disorders. It displays the chamber's changes in diameter and length.Circumferential and radial strain is represented by the diameter aspect, while longitudinal strain is represented by the length aspect. LVEF is influenced by a number of factors, including cardiac stress. Cardiac preload and after load are altered in pathological valve disorders. It becomes difficult to evaluate LVEF in patients with VHD when these circumstances exist. LVEF does not evaluate the cardiac mechanics; rather, it solely represents the relative volume change between the end-diastole and end-systole phases. Consequently, in evaluating heart function under aberrant hemodynamic circumstances, LVEF has limits. A more advanced stage of the illness and irreversible cardiac failure are frequently indicated by impaired LVEF.However, GLS is able to identify any subclinical or early left ventricular impairment. Geometric assumptions have no bearing on the way GLS measures heart function. In a 16-segment model, strain can be used to directly assess myocardial deformation. Due to its increased sensitivity in identifying changes in long axis shortening, GLS might end up being a more useful metric than LVEF. This sensitivity results from the longitudinal strain's susceptibility to injury. Clinical use of GLS in valvular heart diseases: When evaluating cardiac function, GLS outperforms LVEF as a measure. The advantages of GLS over LVEF have also been recognized by the American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging (EACVI).There is little research on the assessment of mitral stenosis using GLS. But a study by Gerede et al. was able to demonstrate how LV GLS is linked to mitral stenosis progression. Patients in this study exhibited a more progressing condition if their GLS value was lower than 16.98%. This study demonstrated that mitral stenosis could be monitored using GLS measurement to assess its progression. 14 Therefore Because global longitudinal strain assessment can identify cardiac dysfunction in patients who are asymptomatic due to compensation by other groups of strain, it is advantageous and preferable to LVEF in the assessment of valvular heart disease. This benefit of GLS can also be utilised to decide on the patients' course of treatment.In poorer nations, the primary cause of Mitral Stenosis (MS) remains the rheumatic inflammatory process. A reduction in the Left Ventricular (LV) preload is significant when the severity of MS increases. Myocardial performance would theoretically alter since the relationships between myocardial tissue architecture, myocardial contractility, preload, and after load dictate LV function.

It has been determined that one of the main causes of myocardial dysfunction is intrinsic cardiac dysfunction. However, despite the abundance of useful information, the literature currently in publication does not provide information on the strain rate, strain, twist, and torsion of the left ventricle in patients with varying degrees of MS severity.By following the displacement of the speckles and measuring strain and strain rate offline, speckle tracking echocardiography is a quantitative ultrasound technique that provides an accurate assessment of the left ventricular systolic function. Subclinical LV dysfunctions that cannot be identified by measuring EF can be found with these more recent methods.

BACKGROUND

It has been determined that one of the main causes of myocardial dysfunction is intrinsic cardiac dysfunction. However, despite this important information, the literature currently in publication lacks information on the strain rate, strain, twist, and torsion of the left ventricle in patients with varying degrees of MS severity.

1) When there is no low preload, a portion of people with moderate multiple sclerosis have been found to have deterioration in their left ventricular systolic performance.
2) Large studies from India are lacking in this regard.
3) The Simpson method to measure left ventricular ejection fraction has its own fallacies because to weak acquisition windows, fore shortening, and inter-observer variation. There is also increased inter-observer variation for left ventricular ejection fraction evaluation via eye balling methods. Therefore, the purpose of this study is to investigate whether speckle tracking echocardiography can change the left ventricular strain in patients with severe (mitral valve area ≤1.5 cm2) and non-severe (mitral valve area > 1.5 cm2) mitral stenosis in order to identify subclinical left ventricular dysfunction prior to the decline of left ventricular ejection fraction to mid range ejection fraction.

RESEARCH QUESTION- What is the role of speckle tracking echocardiography for detection of subclinical left ventricular dysfunction in patients of isolated rheumatic mitral stenosis.

HYPOTHESIS- Speckle tracking echocardiography can detect subclinical left ventricular dysfunction in mitral stenosis patients.

INTRODUCTION

48 mitral stenosis patients with a gls association and mild-to-moderate multiple sclerosis were studied. The MS progression was predicted by intraobserver GLS with a threshold of -16.98%. After directly comparing these relatively new characteristics to LVEF, Lima et al. [20] found that GLS and LVEF correlated more strongly than twist and torsion. Poyraz used 2D and 3D strain echocardiography to measure the left ventricular basal strain, twist angle, and torsion in 31 patients with moderate multiple sclerosis and compared the results to 27 healthy controls.They concluded that, in comparison to the healthy group, the individuals with mild multiple sclerosis exhibited decreased GLS, GCS, and global rotational strain. Furthermore, they showed that there was no discernible difference in the LV twist between the two groups, while the MS group's torsion was noticeably higher. In summary, they stated that early in the course of the illness, subclinical left ventricular dysfunction may occur. It highlighted the possibility of simultaneous three-dimensional myocardial deformation. The compensation of one parameter by another is an additional hypothesis. Consequently, despite the alterations in the myocardial deformation parameters, the global left ventricular function may stay normal. In a prior investigation, the apical segments of the left ventricle were not significantly affected by the decrease indicated by the longitudinal 2D strain analysis, which was more pronounced in all basal and some mid segments. Even if the LVEF was within the normal range, Cramariuc demonstrated that patients with aortic stenosis were linked to a reduced myocardial longitudinal deformation. This result demonstrated that GLS may give VHD patients subclinical cardiac involvement. Myocardial deformation in the longitudinal plane during the systolic phase is represented by GLS. Increased wall stress affects longitudinal left ventricular contraction, which is mediated by subendocardial fibres. Additionally,

some research indicated that the assessment of cardiac function using strain measurement might provide an extra benefit in a number of valve disorders. Additionally, Yingchoncharoen demonstrated that in patients with aortic stenosis who were asymptomatic and had a normal ejection fraction, GLS may predict two outcomes: death and valve replacement (Hazard ratio=1.14, 95% CI 1.01–1.28, p=0.037). 16 According to Stokke, the LVEF can be kept at a normal level by compensating for the longitudinal strain with circumferential strain. Consequently, when the LVEF is still intact, GLS can be utilised to assess early cardiac function in VHD patients.Additionally, it is demonstrated that the longitudinal strain is more reproducible and useful in clinical situations when contrasted with the two other strains (radial and circumferential). Vollema investigated 220 asymptomatic individuals with severe AS who had aortic stenosis using gls correlation. Despite having equivalent LVEF, threshold of 18.2%, Interobserver LV GLS was impaired. In order to test this theory, a study using 2D speckle tracking echocardiography will be conducted to search for evidence demonstrating the use of GLS in predicting early cardiac involvement in RHD MS patients before a detectable anomaly in conventional echocardiography.

METHOD:

Venue of the study : Cardiology department NIC lab of ABVIMS and Dr RML Hospital, New Delhi-110001
Type of study : Observational , cross sectional study.
Duration of study : NOVEMBER 2023 to MARCH 2024

SAMPLE SIZE:

Sample Size Calculation Since 2 groups will be taken for the study, the sample size was calculated based on the expected difference between 2 groups, while adjusting the alpha error for multiple comparisons .
Mostafavi, who provided the following mean GLS data for the two groups:
Pooled standard deviation (σ) = 2.15, difference of means (δ) = 2.59, type I error (α) = 5%, and value of standard normal distribution (Zα) = 1.96 for α = 5% Z1-β = 1.65, Power (1 – β) = 95%, Type II error (β) = 5%
The formula above indicates that the minimum sample size needed is 40 in each group (for a total of 80), assuming 95% Power and 95% Confidence interval.

RESULTS:

The LV Global Longitudinal Strain (GLS), Global Longitudinal Strain Rate (GLsr), Global Circumferential Strain Rate (GCsr), but not Global Circumferential Strain (GCS), were significantly lower in the subgroup with progressive mitral stenosis (17.7%, 1.07s-1, 22.85%, and 1.05s-1 , respectively) compared to the healthy group (19.76%, 1.17 s-1, 24.15%, and 1.27 s-1, respectively) (P = 0.001, 0.032, 0.104, and < 0.001, respectively). Increase in the severity of mitral stenosis was accompanied by a significant decrease in the mentioned parameters.Even in patients of non severe mitral stenosis gls , gcr was abnormal even in the presence of normal EF.

CONCLUSION

Measuring the left ventricle's GLS, GLsr, and GCsr measures revealed a decrease in ventricular function caused by the rheumatic disease. Indexes of the left ventricular function, such as rotation, twist, and torsion, considerably decreased as the severity of the stenosis rose, suggesting that the LV function is more susceptible to loading circumstances than the rheumatic process itself.Reduced EF in vulvular heart disease at the time of operation is a poor indicator of recovery; hence, early referral for surgery may be necessary if preclinical LV degeneration is detected by speckled tracking echocardiography.

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