

## The Impact of Ayurveda-based Ischemia Reversal Program (IRP) and Poly-herbal Medication on Reduction of Resting Myocardial Ischemia'

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### ABSTRACT

**Aims:** To evaluate the effect of an Ayurvedic-based ischemic reversal program (IRP) and a calorie-controlled diet to treat myocardial ischemia in patients with known chronic heart disease (CHD).

**Study design:** Single arm, prospective study.

**Place and Duration of Study:** Madhavbaug Clinics throughout India, between June 2020 and August 2020.

**Methodology:** Patients with myocardial ischemia were screened using 2D speckle tracking global longitudinal strain (GLS) echocardiography. The selected patients underwent a baseline investigation along with a 6-minute walk test and assessment of the left ventricular ejection fraction, end diastolic volume (EDV), stroke volume and left ventricular mass. The study group were administered 14 IRP *Panchakarma* (twice a day) for 7 days and followed a calorie-controlled diet for 30 days. Post 30 days of treatment, the GLS score, 6-minute walk test, left ventricular ejection fraction, EDV, stroke volume and left ventricular mass were measured and compared with the baseline results.

**Results:** On screening 67 patients, 50 patients with a GLS score of  $\geq 16$  were selected for the study. The study population consisted of 43 males aged  $59.37 \pm 10.45$  years and 7 females aged  $63.14 \pm 6.40$  years. Post IRP treatment and calorie-controlled diet, the GLS score and 6-minute walk test result improved thus indicating the improvement in the functional capacity of the patients. The left ventricular ejection fraction, EDV and stroke volume increased thus improving the cardiac output. Reduction in the left ventricular mass was observed which indicates a reduction of the risk of cardiovascular events.

**Conclusion:** The IRP and calorie-controlled diet helped to reduce the myocardial ischemic condition in the study population and the effect of the treatment was evaluated using speckle tracking global longitudinal strain echocardiography.

*Keywords: Myocardial ischemia, Global longitudinal strain, 6-minute walk test, ischemic reversal program, calorie controlled diet, cardiac output*

## 1. INTRODUCTION

Ischemic heart disease (IHD) is characterized by the presence of angina symptoms. Myocardial ischemia results due the interaction between the myocardium and the coronary vessels. It occurs when myocardial supply and demand of oxygen is not balanced (1). Presence of ischemic conditions is an indicator of a coronary artery disease (CAD) and it is therefore important to prevent ischemic events in CAD patients. Prognosis of patients having left ventricular diastole dysfunction (LVDD) is worse due to IHD (2). Statins have proved to reduce the ischemic events (2), however, the use of statins have adverse effects on the muscles causing stiffness and cramps thus, reducing the exercise capacity of the patient.

Functional capacity of the heart reduces in ischemic conditions. A 6-minute walk test helps to measure the functional capacity of the patients (4). Distance walked during the 6-minute walk test was indicative of the rates of heart failure and myocardial infarction with the former being inversely proportional to the latter. The 6-minute walk test is a better predictor of cardiovascular events and mortality as compared to traditional risk factors (5). Heart rate and blood pressure should be monitored at the start and at the end of the test. The test can differentiate between mild to moderate to severe CAD.

The functional capacity of the heart is dependent on the ventricular function. Initially the left ventricular function was evaluated by measuring the left ventricular ejection fraction. Echocardiography was regarded as the best method for evaluating left ventricular heart function. However, in recent studies GLS has been proved to be better to diagnose acute coronary heart disease as compared to left ventricular ejection fraction. The results obtained by left ventricular ejection fraction is dependent on the experience of the analyst and therefore interpretation will vary. But in the case of GLS the results obtained are fairly accurate irrespective of the experience of the analyst. Thus, GLS can predict the development of the cardiac disease better than left ventricular ejection fraction (7, 8). Along with GLS, left ventricular mass (LVM), left ventricular ejection fraction, end diastolic volume (EDV) and stroke volume can also help to predict adverse cardiovascular events.

Panchakarma therapy is an Ayurvedic procedure which boosts immunity, reduces stress, eliminates toxins from the body thereby providing maximum health benefit to the patient. The main focus of the present study was to assess effect of an Ayurvedic-based ischemic reversal program (IRP) and a calorie-controlled diet to treat myocardial ischemia in patients with known chronic heart disease.

## 2.0 MATERIAL AND METHODS

### 2.1. STUDY DESIGN AND POPULATION

A retrospective clinical observational study was carried out on patients with known IHD. These patients had approached the various branches of Madhavbaug Clinics throughout India, with a complaint of angina. The GLS score of all the patients were obtained using 2D speckle tracking GLS echocardiography in order to select the study participants. The study inclusion was stable ischemic heart disease patients with GLS  $\geq 15$ . The study exclusion was unstable angina, GLS  $\leq 15$ , chronic IHD patients, acute coronary syndrome, and unwillingness to partake in the trial. The study was conducted in accordance with ethical standards as outlined by the Declaration of Helsinki. Written informed consent with publication of data without disclosure of personal information was obtained from all study patients before commencement of the study.

## 2.2. STUDY EVALUATION

After selection of the patients for the study, anthropometric measurements consisting of the weight, body mass index and abdominal girth (ABG) were measured. A blood test to measure the lipid profile, glycated hemoglobin (HbA1c) and the ratio of the blood urea nitrogen/serum creatinine was carried out as a part of the baseline investigation.

The primary endpoint of the study was considered as a change in the GLS score from the baseline. GLS at day 1 and day 30 of the treatment was measured using 2D speckle tracking echocardiography. For evaluating the secondary endpoints, the patients were studied using an echocardiogram to measure the LVM, stroke volume, end diastolic volume (EDV) and the left ventricular ejection fraction. After the period of 30 days, the anthropometric measurements and the echocardiogram were performed to identify any change from the baseline results. A 6-minute walk test was also performed before and after the treatment to evaluate the functional capacity of the heart.

## 2.3. STUDY THERAPY

The patients under study were given a total of 14 Panchakarma treatments twice a day for the period of 7 days. The Panchakarma treatment consisted of 3 steps- centripetal oleation, thermal vasodilation and per rectal herbal decoction administration details of which is mentioned in previous published papers (10). Centripetal oleation helps to improve cardiac output and vasodilation and reduces inflammation and causes the loss of excessive salts and water by sweating and per rectal herbal decoction administration reduces lipid, water overload and oxidative stress of the body. The patients were prescribed with Tab GHA 2tb twice a day (BD) before meal and ARJ Kadha 10 ml BD post meal for 30 days. They were also advised a calorie-controlled diet for 30 days. The daily calorie intake of the study patients was 1000cal/day.

## 2.4. STATISTICAL ANALYSIS

The data obtained was analyzed using Anova single factor and the mean  $\pm$  SD was calculated for all the parameters tested. A p-value of  $<0.05$  was considered as significant. A paired two sample t-test was carried out in order to analyze the results for the GLS parameter. Excel 2013 was used to analyze the data.

## 3.0 RESULTS AND DISCUSSION

### 3.1. STUDY POPULATION

After screening 67 patients, 50 patients (86% male and 14% female) with a GLS score  $\geq 16$  and who were ready to take treatment for 7 days with a follow up after 1 month were selected for the study. The males belonged to the age group  $59.37 \pm 10.45$  years and females belonged to the age group  $63.14 \pm 6.40$  years. The patients with unstable angina, acute illness and a GLS score of  $\leq 16$  were excluded from the study.

The study population had co-morbidities of which CAD, hypertension and diabetes mellitus was the major co-morbidity observed in the study population.

### 3.2. STUDY EVALUATION

### **3.2.1. Baseline investigations**

The patients had to undergo a baseline investigation as shown in Table 1, at day 1 of their inclusion in the study group. These test were performed to assess the overall health of the patients. The mean  $\pm$  SD for each parameter was calculated. On comparing with the results of the study population with the reference range, all the parameters were within the desired range.

Table 1- Day 1 results of the baseline investigations carried on the study population.

<b>Test</b>	<b>Day 1 (mean <math>\pm</math> SD)</b>
Total protein	6.38 $\pm$ 1.55 g/dL
BUN	16.50 $\pm$ 12.97 mg/dL
Serum creatinine	1.216 $\pm$ 0.54 mg/dL
BUN/Serum creatinine ratio	35.44 $\pm$ 32.24
Cholesterol	127.192 $\pm$ 30.86 mg/dL
Triglycerides	129.868 $\pm$ 57.07 mg/dL
HDL	43.114 $\pm$ 11.40 mg/dL
LDL	58.162 $\pm$ 20.67 mg/dL
LDL/HDL ratio	2.11 $\pm$ 2.10
HbA1c	7.26 $\pm$ 1.97 %

Index: BUN- Blood urea nitrogen; HDL- high density lipids; LDL- low density lipids; HbA1c - glycated hemoglobin

### **3.2.2. Anthropometric measurements**

The IRP helped to reduce the weight (66.76 kgs  $\pm$  9.99 to 62.98 kgs  $\pm$  8.75, p-value=0.05), ABG (94.96 cm  $\pm$  9.63 to 90.72 cm  $\pm$  8.47, p-value= 0.022791) and the body mass index (24.85  $\pm$  3.46 kg/m<sup>2</sup> to 23.44  $\pm$  3.05 kg/m<sup>2</sup>, p-value=0.035668) of the study population within 30 days of treatment. All the parameters were observed to be statistically significant.

### **3.2.3. Global Longitudinal strain (GLS)**

GE Healthcare Vivid S6 Ultrasound System (Wauwatosa, USA), an echocardiography machine was used for the study according to American Society of Echocardiography guideline (11). The left ventricular function was measured using left ventricular ejection

fraction and 2D speckle tracking to determine the global longitudinal strain. The test was carried out within the span of 24 hours before and after post-percutaneous coronary intervention procedure. A total of 18 segments were used to calculate the left ventricular global longitudinal peak strain average (GLPS-Avg). The vertical segments were basal, mid, and apical and horizontal segments were anterior, anteroseptal, inferoseptal, posterolateral, inferior, and anterolateral. Apical long axis (APLAX) was used to view the anterior and inferior segments, Apical 4-chambers (4-Ch) was used to view anterolateral and inferoseptal segments and Apical 2-chambers (2-Ch) was used to view anteroseptal and posterolateral segments.

The primary endpoint of the study was considered as a change in the GLS from the baseline results. There was an improvement observed in the GLS score post 30 days of treatment. (Figure 1)

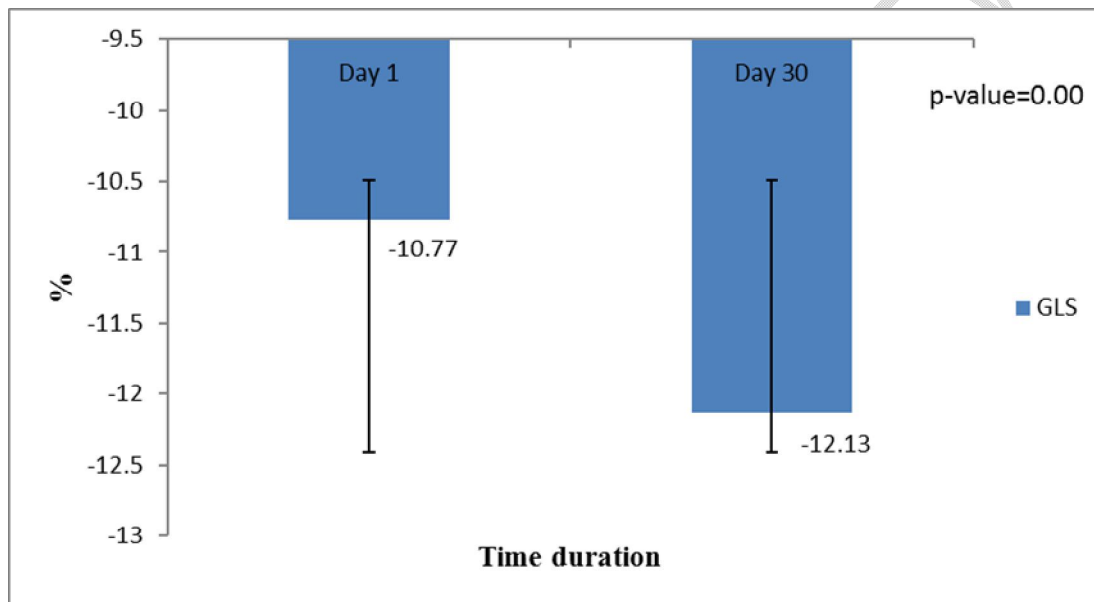


Figure 1- Comparison of GLS levels before and after 30 days of treatment.

#### **3.2.4. 6-minute walk test**

Out of the 50 study patients only 20 patients carried out the 6-minute walk test. The rest of the patients showed low left ventricular ejection values and were not included in the test. It was observed that after the treatment, the mean distance covered increased by 29.27%. The heart rate and blood pressure was monitored before and after performing the test and the readings were within the desired range. (Figure 2 and Figure 3)

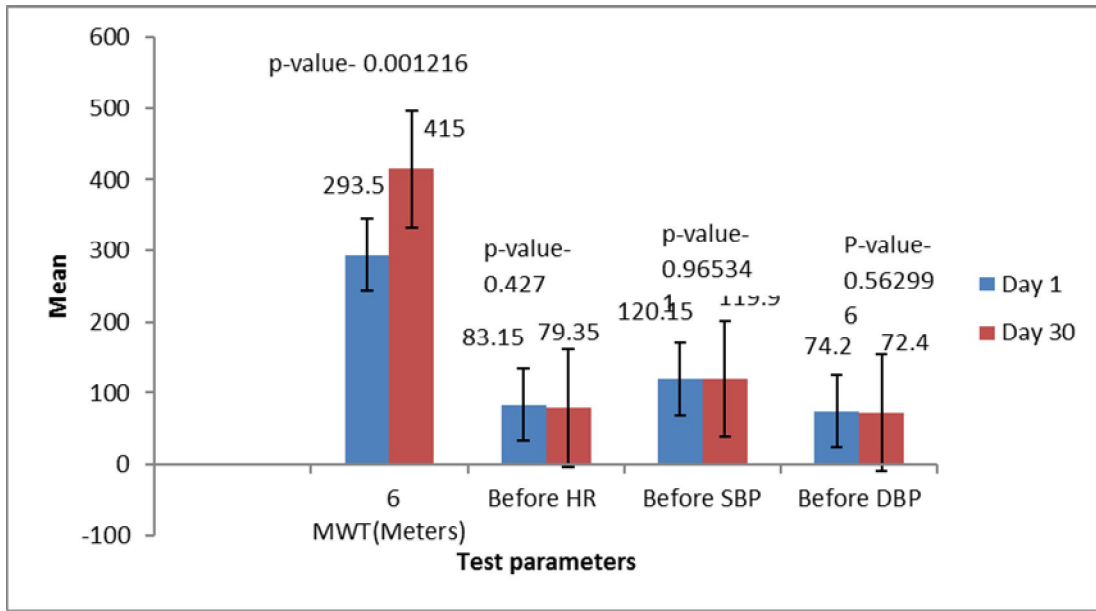


Figure 2: Comparison between 6-minute walk test before and after 30 days of treatment. During the test, heart rate (HR), Systolic blood pressure (SBP) and diastolic blood pressure (DBP) was noted and compared before the start of the 6-minute walk test. at day 1 and day 30 of the treatment. HR is measured in beats per minute, SBP and DBP is measured in mm of Hg.

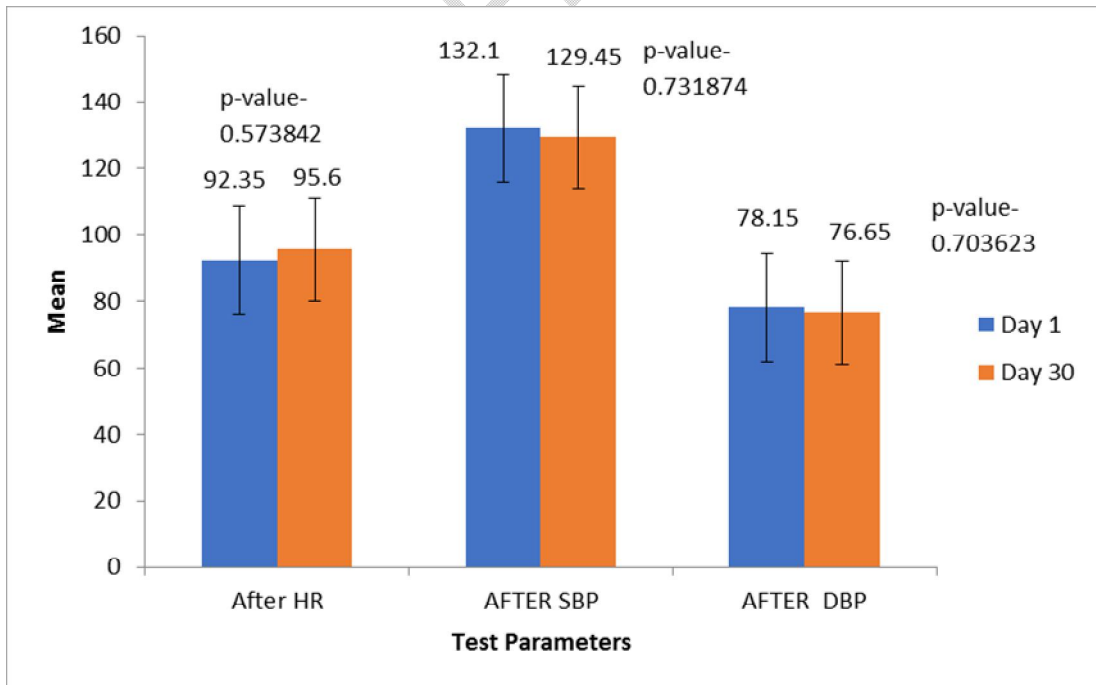


Figure 3: Comparison of the heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) after performing the 6-minute walk test on day 1 and day 30 of the treatment. HR is measured in beats per minute, SBP and DBP is measured in mm of Hg.

### **3.2.5. Echocardiogram test**

The left ventricular ejection fraction, EDV and stroke volume increased by after the treatment whereas the LVM reduced details of which is seen in Table 2. The left ventricular ejection fraction improved post treatment, however did not reach the normal range. EDV and stroke volume improved and maintained in the normal range.

Table 2: Comparison of the echocardiogram test before and after the treatment.

Test	Day 1 (mean $\pm$ SD)	Day 30 (mean $\pm$ SD)	p-value
LVEF	43.6 $\pm$ 12.73 %	47.52 $\pm$ 11.46 %	0.112411
EDV	130.26 $\pm$ 59.22 ml	138.41 $\pm$ 49.26 ml	0.479834
Stroke volume	76.86 $\pm$ 47.64mL/beat	77.09 $\pm$ 43.02 mL/beat	0.981074
LVM	114.38 $\pm$ 36.75 gms	113.88 $\pm$ 27.76 gms	0.942979

Index: LVEF- Ejection fraction, EDV- end diastole volume, LVM - left ventricular mass

## **4.0 DISCUSSION**

Recent developments in speckle-tracking echocardiography have enabled the quantitative assessment of myocardial function – GLS is one such important technique afforded through this development. This technique enables detection of subtle changes despite normal left ventricular ejection fraction. These detectable changes lead to prediction of cardiovascular events in the general population (12). Several studies have validated its utility in varying patient populations. The Copenhagen City Heart Study (13) sought to assess the validity of GLS as a parameter to identify individuals at increased risk of future cardiovascular morbidity and mortality. Study findings revealed lower GLS was associated with higher risk of the composite endpoint comprising incident heart failure, acute myocardial infarction, or cardiovascular death. The present study focused on assessing the effect of an Ayurvedic-based IRP and a calorie-controlled diet to treat myocardial ischemia in patients with known chronic heart disease. The primary endpoint was the change in GLS post 30 days of treatment. GLS is considered to be reduced mildly when it falls in the range of -15% and -12.5%, reduced moderately when it falls in the range of -8.1% and -12.5% and reduced severely when it falls below -8.0% (14). In the present study, GLS reduced from -10.77% to -12.13%. This reflects moderate reduction of systolic function with potential further reduction beyond 30 days. A similar study observed a change from -10.35  $\pm$  3.11% to -11.80  $\pm$  3.48% after 30 days (15). Another similar study (16) documented a change from -10.26  $\pm$  4.02% to -10.99  $\pm$  3.94% after 7 days.

The secondary endpoints were assessment of left ventricular ejection fraction, EDV, stroke volume and LVM. An increase in the left ventricular ejection fraction, EDV and stroke volume was observed post treatment. The left ventricular ejection fraction was below the normal range of 50-70% and may increase with further IRP treatment. The EDV and stroke volume though within the normal range at the start of the study, improved by the end of the 30 days

period. Increased LVM is related to diastolic dysfunction. A reduction in the mass will help to improve the diastolic function. The treatment given helped to lower the mean LV mass of the study group thus improving the ischemic condition (17). Thus, along with improving the GLS score, the IRP treatment and calorie-controlled diet helped to achieve an improvement in the left ventricular ejection fraction, EDV, stroke volume and LVM leading to the reduction in the risk of myocardial ischemia.

## **5.0 CONCLUSION**

An improvement in the GLS score led to the improvement in the systolic function of the study population. GLS helps to better diagnose chronic heart disease as compare to LVEF. The myocardial ischemic condition reduced as a result of the IRP and calorie-controlled diet. The treatment also resulted in improving the cardiac output by reducing the LV mass and improving the EF, EDV and stroke volume. The improved 6MWT results proved that the treatment was beneficial in increasing the functional capacity of the patients under the study.

UNDER PEER REVIEW

## 6.0 REFERENCES

1. Rezende PC, Ribas FF, Serrano CV Jr, Hueb W. Clinical significance of chronic myocardial ischemia in coronary artery disease patients. *J Thorac Dis.* 2019 Mar;11(3):1005-1015.
2. Remme WJ. Overview of the relationship between ischemia and congestive heart failure. *Clin Cardiol.* 2000 Jul;23(7 Suppl 4):IV4-8.
3. Bonfim MR, Oliveira AS, do Amaral SL, Monteiro HL. Treatment of dyslipidemia with statins and physical exercises: recent findings of skeletal muscle responses. *Arq Bras Cardiol.* 2015 Apr;104(4):324-31.
4. Pollentier B, Irons SL, Benedetto CM, Dibenedetto AM, Loton D, Seyler RD, Tych M, Newton RA. Examination of the six minute walk test to determine functional capacity in people with chronic heart failure: a systematic review. *Cardiopulm Phys Ther J.* 2010 Mar;21(1):13-21
5. Beatty AL, Schiller NB, Whooley MA. Six-minute walk test as a prognostic tool in stable coronary heart disease: data from the heart and soul study. *Arch Intern Med.* 2012 Jul 23;172(14):1096-102.
6. Zielińska D, Bellwon J, Rynkiewicz A, Elkady MA. Prognostic value of the six-minute walk test in heart failure patients undergoing cardiac surgery: a literature review. *Rehabil Res Pract.* 2013;2013:965494.
7. Karlsen S, Dahlslett T, Grenne B, Sjøli B, Smiseth O, Edvardsen T, Brunvand H. Global longitudinal strain is a more reproducible measure of left ventricular function than ejection fraction regardless of echocardiographic training. *Cardiovasc Ultrasound.* 2019 Sep 2;17(1):18
8. Park JJ, Park JB, Park JH, Cho GY. Global Longitudinal Strain to Predict Mortality in Patients With Acute Heart Failure. *J Am Coll Cardiol.* 2018 May 8;71(18):1947-1957.
9. Bouzas-Mosquera A, Broullón FJ, Álvarez-García N, Peteiro J, Mosquera VX, Castro-Beiras A. Association of left ventricular mass with all-cause mortality, myocardial infarction and stroke. *PLoS One.* 2012;7(9):e45570.
10. Sane R, Wadekar A, Shinde K, Furia H, Upadhyay P, Mandole R. Understanding the role of ayurveda based ischemia reversal program and low carbohydrate diet in reduction of risk of heart disease. *Asian J Cardiol Res.* 2019;2(1):1–8.
11. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, Flachskampf FA, Foster E, Goldstein SA, Kuznetsova T, Lancellotti P, Muraru D, Picard MH, Rietzschel ER, Rudski L, Spencer KT, Tsang W, Voigt JU. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *J Am Soc Echocardiogr.* 2015 Jan;28(1):1-39.e14.
12. Yingchoncharoen T, Agarwal S, Popović ZB, Marwick TH. Normal ranges of left ventricular strain: a meta-analysis. *J Am Soc Echocardiogr.* 2013 Feb;26(2):185-9

13. Biering-Sørensen T, Biering-Sørensen SR, Olsen FJ, Sengeløv M, Jørgensen PG, Mogelvang R, Shah AM, Jensen JS. Global longitudinal strain by echocardiography predicts long-term risk of cardiovascular morbidity and mortality in a low-risk general population: The Copenhagen City Heart Study. *Circ Cardiovasc Imaging*. 2017 Mar;10(3):e005521
14. Vijayaraghavan G, Sivasankaran S. Global longitudinal strain: A practical step-by-step approach to longitudinal strain imaging. *J Indian Acad Echocardiogr Cardiovasc Imaging*. 2020;4(1):22–8.
15. Sane R, Manohar P, Mandole R, Amin G, Ghadigaonkar P, Dongre S, Yanshwantrao P, Patil D, Jadhav R. Impact of Ayurveda based ischemia reversal program (IRP) and polyherbal medication on reduction of resting myocardial ischemia with speckle tracking global longitudinal strain imaging in type 2 diabetes mellitus patients. *International Journal of Innovative Research in Medical Science*. 2022;7(8):416–419.
16. Sane R, Manohar P, Mandole R, Amin G, Ghadigaonkar P, Patil D, Dongre S, Jadhav R, Yanshwantrao P. Impact of Ayurveda-based Ischemia Reversal Program on reduction of resting myocardial ischemia studied with speckle-tracking global longitudinal strain imaging. *J Indian Coll Cardiol*. 2022;12:106-10.
17. Turakhia MP, Schiller NB, Whooley MA. Prognostic significance of increased left ventricular mass index to mortality and sudden death in patients with stable coronary heart disease (from the Heart and Soul Study). *Am J Cardiol*. 2008 Nov 1;102(9):1131-5.