INTRODUCTION

The coronary artery disease (CAD) is a highly progressive disease even after the mean time of 11.2 years after coronary artery bypass graft (CABG) surgery by occlusion and stenosis. (Borowskia, Vchivkov I, Ghodsi zad A, 2008) Mortality rate increases gradually by 5th year (Weintraub Ws1, Jones EL, Morris DC, King SB 3rd, Guyton RA, 1997), 6th year (Shahian et al., 2012) and 11 years (Borowskia, Vchivkov I, Ghodsi zad A, 2008) follow-up even after CABG. Conventional rehabilitation can significantly reduce mortality than standard medical care in coronary heart disease (CHD).

(Denollet J1, 1AD) Targeting the risk factor managements, (Borowskia, Vchivkov I, Ghodsi zad A, 2008; Khot et al., 2003) like lifestyle modification program which can reduce the stenosis of coronary artery at 5th year follow up, (Pischke, Scherwitz, Weidner, and Ornish, 2008a) health promotion programs enhance the awareness of healthy behavior and well-being after 3months of CAD (Safabakhsh, Jahantigh, Nosratzehi, and Navabi, 2016) and intensive effort on risk factor modifications by involvement of doctors at primary health care center can bring significant benefits for CHD patients. (Roberts A, 1998) Lifestyle programs are mainly for reducing the risk factors, (Razavi, 2014) reversal of atherosclerosis (D Ornish et al., 1998) and for avoiding the revascularization (Dean Ornish, 1998) of CHD. Cardiac rehabilitation/ secondary prevention programs can reduce morbidity, mortality and enhance the physical and emotional.
well-being of coronary heart disease (CHD) people. (Patrick D.
Savage et al., 2011). Rehabilitation programs either supervised or home based can positively reduce the cardiac risk factors like systolic blood pressure, total cholesterol. (Jolly, Taylor, Lip, and Stevens, 2006) Yoga based rehabilitation (YLSP) improves ejection fraction (EF) compared with physiotherapy rehabilitation program after one year of CABG. (Nagaratha Raghuram et al., 2014) Improved EF may underestimate the heart function after 10 of CAB G, hence the deformation parameters should be interpreted in relation to changes in ventricular geometry and ventricular viability. (Blumenthal et al., 2005; Rösner A1, Avenarius D1, Malm S1, 2, Iqbal A1, Schirmer H1, 2, Bijens B3, 4, Myrmel T1, 2015) Ventricular wall movement abnormalities can be reduced significantly with the combination of exercise and stress management programs in heart disease patients irrespective of baseline characteristics. [16] The ventricular contractions based on the autonomic nervous system control may become hypotrophic or hypertrophic and leads to structural changes like cardiomegaly or valvular diseases. Hence it is important to analyze the myocardial or ventricular movement or contractions as a screening tool along with EF. Considering the high progression rate of CAD, long term effects of life style program in terms of EF and the ventricular viability are to be evaluated. Hence the primary purpose of present study is to evaluate the EF after 6 years of CABG and secondly, evaluate the LV wall motion between YLSP and CLSP.

MATERIALS AND METHODS

Recruitment process

In brief, out of 1026 patients who posted for CABG were screened and selected 300 for our study from Narayana Hrudayalaya Institute of Cardiac Sciences (NHICSc), Bangalore from 2005-2007. The study got trial registry as with registry number CTRI/2008/09/000293 and prepared as per consort guidelines. This is a successfully completed study by 2008 and were met by 5th year and followed up without fund for 6th year study. They were allocated into two groups of 150 each using computer generated random number table (www.randomizer.org) by a statistician at the university centre. As per the availability, we included men alone, who was diagnosed with double or triple vessel disease and minimum 30% of EF and who reside 200 Km from the NHICSc. Men with associated valvular disease, valvular surgery, physical disability, renal failure, experience in yoga, and emergency CABG were excluded. After checking the demographic commonality, the intervention was implemented for one year and drawn the conclusions as both interventions are beneficial in improving EF. Same subjects were contacted at the 5th year of post CABG life by telephonic calls, letters by our technicians. This kind of follow up gives some more view of the risk factors and their role in healthy life after the discharge from hospital.(Lear et al., 2003) The treatments were explained and got the confirmation from the subjects (Figure-1). We continued the norms of the scheme based on the low income rate and provided free check up at every contact session from the medical departments and free treatments from yoga department.

Study design

Randomized controlled trial, single blind, prospective study. The researcher is blind to the participant’s groups. Institutional Ethical Clearance was obtained.

![LV Viability](image)

**Legend:** n- Sample size, LV-Left Ventricle, CLSP- Conventional Lifestyle Program, YLSP- Yoga based Lifestyle Program, d= Effect size.

**Figure 1. Comparison of sub groups of LV viability**

**Measurement tool**

Echocardiography is a standard measure used for cardiac diseases. This is by Echocardiogram, GE company Version 5.00, Narway 2000. An echocardiogram (also known as echo, transthoracic echocardiogram or TTE, exercise or stress echocardiogram) is a noninvasive (the skin is not pierced) procedure used to assess the heart’s structure and function. A transducer (like a microphone) sends out ultrasonic sound waves at a frequency too high to be heard. When the transducer is placed on the chest at a certain location and angles, the ultrasonic sound waves move through the skin and other tissues to the heart tissues, where the waves echo off from the heart structures. The traducer can pick up the reflected waves and sends them to a computer. The computer interprets the echoes into images of the heart walls and valves. Among various variables, the ejection fraction (LVEF), LV movements in terms of fair LV systolic function, concentric LV hypertrophy. (Nagaratha Raghuram et al., 2014) Left Ventricular function as mention in Echo report was divided as moderate and severe. “Fair LV systolic function” is considered as “LV moderate” and “concentric LV hypertrophy” is considered as “LV severe”. Baseline and 6th year data were recorded by a qualified technician from NHICSc.

**Intervention**

(1) YLSP- breathing practices, loosening practices (sukshma vyayama), yoga exercises (Asana) in standing, sitting, prone and supine lying, yogic breathing (Pranayama), meditation, relaxation techniques, advanced relaxation, devotional session and lectures (Table-3). (2) CLSP- breathing exercises, body exercises in standing, sitting in a chair and supine rest (Table-4). These were taught at the contact session and provided all the practices in a CD form for their guidance.

**Data Analysis**

Using SPSS, demographic data of age, weight, height, and BMI were analysed using Independent samples test (Table-1). Paired Samples ‘t’ test was used for the baseline to 6th year comparison. Independent samples ‘t’ test was used to compare the baseline and at 6th year data (Table-2). The effect size for EF directed the study to continued the analysis with subdivision of LV viability for both the groups with Paired Samples ‘t’ test and separately with Independent samples ‘t’ test (Figure-1).
RESULTS

Total patients of 50 and 54 in CLSP and YLSP respectively gave the Echo reports at the end of the 6th year. The data is tabulated, analyzed by using SPSSS. The results were reported in terms of p-values of Paired Samples ’t’ test and Independent Samples ’t’ test. Table-2 shows the means and SD and p-values of EF from baseline to 6th year of YLSP and CLSP.

<table>
<thead>
<tr>
<th>Demography</th>
<th>Sub grading</th>
<th>CLSP (Mean±SD) (n)</th>
<th>YLSP (Mean±SD) (n)</th>
<th>Independent Samples ’t’ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Total</td>
<td>52.96±5.9 (50)</td>
<td>53.44±6.4 (54)</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>LV Moderate</td>
<td>53.26±5.8 (19)</td>
<td>53.17±7.6 (24)</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>LV Severe</td>
<td>52.77±6.0 (31)</td>
<td>53.67±5.4 (30)</td>
<td>0.78</td>
</tr>
<tr>
<td>Weight</td>
<td>Total</td>
<td>65.72±8.4 (50)</td>
<td>68.33±8.0 (54)</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>LV Moderate</td>
<td>65.89±9.4 (19)</td>
<td>67.50±8.9 (24)</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>LV Severe</td>
<td>65.61±7.9 (31)</td>
<td>69.00±7.3 (30)</td>
<td>0.5</td>
</tr>
<tr>
<td>Height</td>
<td>Total</td>
<td>163.56±5.5 (50)</td>
<td>164.46±6.3 (54)</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>LV Moderate</td>
<td>165.68±4.0 (19)</td>
<td>164.83±5.3 (24)</td>
<td>0.03</td>
</tr>
<tr>
<td>BMI</td>
<td>Total</td>
<td>24.52±2.6 (50)</td>
<td>25.31±3.1 (54)</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>LV Moderate</td>
<td>24.00±2.9 (19)</td>
<td>24.79±2.8 (24)</td>
<td>0.28</td>
</tr>
<tr>
<td>Echo</td>
<td>LV viability</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>19 (44.2)</td>
<td>24 (55.8)</td>
<td>p-value=0.50</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>31 (50.8)</td>
<td>30 (49.2)</td>
<td>Chi value=0.44</td>
</tr>
</tbody>
</table>

Note: There is no significant demographic difference between the groups at baseline including LV viability.

Legend: n- Sample size, LV- Left Ventricle, CLSP- Conventional Lifestyle Program, YLSP- Yoga based Lifestyle Program, BMI- body mass index.

Table 2. Comparison of grading EF at baseline and 6th year

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Baseline (Mean±SD)</th>
<th>6th year (Mean±SD)</th>
<th>P value</th>
<th>d value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF</td>
<td>CLSP</td>
<td>50</td>
<td>51.12±6.9</td>
<td>53.08±5.8</td>
<td>0.109</td>
</tr>
<tr>
<td></td>
<td>YLSP</td>
<td>54</td>
<td>52.52±7.5</td>
<td>54.54±5.5</td>
<td>0.004**</td>
</tr>
<tr>
<td>P value</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p<0.005 Significant improvement of EF in YLSP compared to CLSP at 6th year

Legend: n- Sample size, LV-Left Ventricle, EF- Ejection fraction, CLSP- Conventional Lifestyle Program, YLSP- Yoga based Lifestyle Program, d= Effect size. * p<0.05,

EF

It is improved in YLSP from baseline (M=52.52, SD=7.5) to 6th year (M=54.54, SD=5.5), t(53)=-1.63, p=0.004, d=0.41 than CLSP group from baseline (M=51.12, SD=6.9) to 6th year (M=53.06, SD=5.8), t(49)=2.98, p=0.01, d=0.23 (Paired Sample ‘t’ test). But there is no group differences at baseline (M=51.12, SD=6.9), (M=52.52, SD=7.5), t(102)=-0.98, p=0.33 and at 6th year (M=53.06, SD=5.8), (M=54.54, SD=5.5), t(102)=-1.31, p=0.19 (Independent samples ‘t’ test). The effect size is near moderate in YLSP and low in CLSP.

LV viability-Moderate

YLSP shown non-significant improvement from baseline (M=56.50, SD=3.95) to 6th year (M=56.00, SD=4.49), t(23)=0.85, p=0.403, d=0.173 (Paired Samples ‘t’ test). CLSP shown non-significant improvement from baseline (M=54.79, SD=5.18) to 6th year (M=53.74, SD=4.98), t(18)=-0.77, p=0.448, d=0.178 (Paired Samples ‘t’ test). Between group analysis is statistically non-significant at baseline (M=54.79, SD=5.1), (M=56.50, SD=3.9), t(41)=-1.22, p=0.22 and at 6th year (M=53.74, SD=4.9), (M=56.00, SD=4.4), t(41)=-1.56, p=0.12 (Independent Samples ‘t’ test in figure-1). The effect size is lower in both the groups.

LV viability-Severe

YLSP shown significant improvement from baseline (M=49.33, SD=8.27) to 6th year (M=53.37, SD=6.11), t(29)=-4.093, p=0.001, d=0.74 (Paired Samples ‘t’ test). CLSP shown significant improvement from baseline (M=48.87, SD=6.99) to 6th year (M=52.65, SD=6.39), t(30)=-2.27, p=0.03, d=0.4 (Paired Samples ‘t’ test). Between group analysis is statistically non-significant at baseline (M=48.87, SD=6.9), (M=49.33, SD=8.2), t(59)=-0.23, p=0.81 and at 6th year (M=52.65, SD=6.3), (M=53.37, SD=6.1), t(59)=-0.45, p=0.65
(Independent Samples ‘t’ test in figure-1). The effect size is higher in YLSP and moderate in CLSP group.

**DISCUSSION**

Statistically, significant improvement seen in YLSP than CLSP at the end of 6th year as seen in the previous study which was a one year follow up. (Nagarathna Raghuram et al., 2014) EF improves with exercises and stress management programs but does not showed any group differences. (Blumenthal et al., 2005) Yoga can modulate blood pressure, heart rate through autonomic nervous system arousal and also can reduce the cortisol modulation through Hypothalamos-Pituitary axis. (Evans, Cousins, Tsaio, Sternlieb, and Zeltzer, 2011; Padgett and Glaser, 2003) Yoga can increase the heart rate variability and vagal dominance through the general perception of the subjects in YLSP (Sohl, Wallston, Watkins, and Birdee, 2016). The myocardial viability abnormalities still happen after CABG (Gutberlet et al., 2005) which can be improved in terms of EF and myocardial viability. (Carrel et al., 1992) The left ventricle stiffness is more on affected side compared to unaffected side in pre op CABG and is reduced post operatively in terms of increased LV mobility. (Higashita et al., 1996) Hence EF alone is not the predictor of LV function, but it is the muscle performance too. (Rösner A1, Avenarius D1, Malm S1, 2, Iqbal A1, Schirmer H1, 2, Bijnen B3, 4, Myrmtel T1, 2015) For knowing the events other than EF, the LV viability was analyzed as LV moderate and LV severe. Patients with LV severe improved in both the groups at the end of 6th year but still more in YLSP group than CLSP. EF improvement is associated with significant reduction of wall movement abnormalities and improvement of baroreflex sensitivity when combine the exercise and stress management (Blumenthal et al., 2005; Manchanda, 2014). Yoga works by the enhanced parasympathetic activity, alternate nostril breathing exercise can reduce the blood pressure, pulse rate and respiratory rate. (Upadhyay Dhungel, Malhotra, Sarkar, and Prajapati, 2008) Patients who present without risk factors tend to present at later age once their baseline risk is enough to cause disease (Canto et al., 2011). This is because of stressful lifestyle which can be handle with yoga. (Kiecolt-glaser and Christian and Heather Preston et al., 2010; Nagarathna Raghuram et al., 2014; Padgett and Glaser, 2003).

Hence lifestyle programs which target the risk factors may be the cause for overall improvements (Lear et al., 2003) in both groups after 6 years. Physiotherapy based rehabilitation improves the balance, stability and performance of activities of daily living in elderly people by increasing muscle strength. (Cacciatore, Mian, Peters, and Day, 2014; Schot, Knutzen, Poole, and Mrotek, 2003) Through the role physical and general health perception yoga can reduce the risk of metabolic syndrome. (Sohl et al., 2016) Increasing the physical workload will reduce the risk factors (Kamel and Obaya, 2016; Tanasescu et al., 2015) and this has more impact in YLSP because of more number of physical practices than CLSP. Apart from these physical level practices, the relaxation sessions are more in yoga group. Stress management includes the relaxation session alone can reduce the diameter of stenosis than exercises after 5 years of retreat program by reducing the psychological distress in CHD. (Pischke, Scherwitz, Weidner, and Ornish, 2008b) Circadian influence because of disturbed sleep, shifting light-dark patterns disturb the leukocyte and lipid supply in the circulation and leads to atherosclerosis. (McAlpine and Swirski, 2016) Special breathing techniques called pranayama can potentially reduce the oxidative stress. (Bhatnagar, Tripathi, and Kumar, 2016; Gordon, McGrowder, Pena, Cabrera, and Lawrence Wright, 2013; Wiwanitkit, 2012) Yoga can reduce the blood pressure with maintained peak expiratory flow rate in hypertensive patients (Srivastava, Jain, and Singhal, n.d.) which may be the reason for significant improvements in YLSP. Pranayama change the heart rate variability by modulating the autonomic nervous system. (Lee and Ghiya, 2012). Usually, additional surgeries required along with the CABG to improve the LV viability in long terms like; 2 years, (Marchenko, Chernyavsky, Efendiev, Volokitina, and Karaskov, 2011) 3 years, (Davoodi S1, Sheikhhvatan M, Karimi A, Ahmadi SH, Goodarznejad H, 2012) but that is not required in the present study even at 6year of CABG life. The LV viability improves with CABG, (Krittayaphong et al., 2008; Nagarathna Raghuram et al., 2014) but still results in mismatch of myocardial blood flow and metabolism (Koofed et al., 2002) after CABG. In the present study, the LV viability changed from severe to moderate accordingly with EF in YLSP. A small difference of LV viability change between groups may be of comparatively small sample size, fewer practices in CLSP than YLSP. Usually low income areas will adopt the lifestyle changes programs very less. (Teo et al., 2013) In the present study the interventions applied in low economic level males with provided benefits. So the study protocol is considered to be economical as per the requirement. (Patrick D. Savage et al., 2011) This is the first attempt disclosed the LV functions as EF and Viability after 6 years of CABG life. This concept has to be done in large sample size. The comparison can be with some more added biochemical variables, psychological variables. Interventions could be similar in quantity. Last but not least is the supervised program in rural areas.

**Conclusion**

The yoga based lifestyle program (YLSP) improves the ejection fraction and left ventricular (LV) viability after 6years of CABG life.

**Acknowledgement**

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**REFERENCES**


