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RESEARCH ARTICLE

EFFECTIVENESS OF YOGA BASED LIFE STYLE PROGRAM ON EJECTION FRACTION AND LEFT VENTRICULAR VIABILITY AT THE END OF 6TH YEAR OF CORONARY ARTERY BYPASS GRAFT (CABG) SURGERY

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ABSTRACT

Progression of CAD is very high even after CABG because of risk factors and improper lifestyle. Left ventricular (LV) movement and ejection fraction (EF) can predict the prognosis. There is a necessity to find out the lifestyle interventions which can target the EF and LV movement in this specific geriatric group. The aim of the study is to improve the ejection fraction and LV performance at 6th year of CABG males.

Methodology: Patients were recruited with randomized controlled trial and implemented yoga based lifestyle and conventional lifestyle programs from 2005, a previous project from Narayana Hrudayalaya, Bangalore. This project was completed by 2007 projecting YLSP as the best treatment. Later in 2012 that is in their 5th year of CABG life were contacted through phone calls and post cards and revised the treatment protocols. They were included with given freedom of either continuing or implementing new changes in the treatment programs. Out of 150 subjects in each group, 50 in conventional lifestyle program (CLSP) and 54 in yoga based lifestyle programs (YLSP) were shown interest in continuing the protocols and gave the Echo reports at the end of 6th year.

Intervention: YLSP and CLSP administered in the contact session at 5th year of CABG providing CD of all practices.

Results: YLSP shown significant improvement of ejection fraction (EF) at the end of 6th year with effect size in CLSP (d = 0.23) in YLSP (d = 0.41) groups. Further sub-group analysis done on LV viability (Severe and Moderate). LV severe in YLSP ($p<0.001$, Paired Samples 't' test, d=0.7). LV severe in CLSP shown significant improvement of EF ($p<0.03$, Paired Samples 't' test, d=0.4). There is no significant change between the groups ($p>0.05$) but LV function changed from severe to moderate at 6th year.

Conclusion: Both the groups showed improvements of EF at the 6th year of CABG life of males with moderate to high effect.

Key words: Ejection fraction, Left Ventricular function, Yoga based Life Style program (YLSP), Conventional Life Style Program (CLSP).

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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 l, Ghodsizad 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 l, Ghodsizad A, 2008) follow-up even after CABG. Conventional rehabilitation can significantly reduce mortality than standard medical care in coronary heart disease (CHD).

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(Denollet J1, 1AD) Targeting the risk factor managements, (BorowskiA, Vchivkov l, Ghodsizad 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. (Nagarathna 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, Bijnens 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 venricular contractions based on the autonomic nervous system control may become hypotrophic or hypertrophic and leads to structural changes like cardiomegaly or vavular diseases. Hence it is important to analys the myoardial 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.

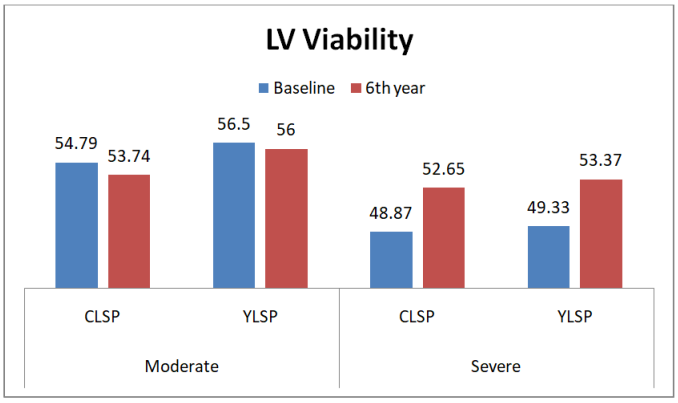
MATERIALS AND METHODS

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 registery number CTRI/2008/091/000293 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.



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. (Nagarathna 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 sub-division of LV viability for both the groups with Paired Samples 't' test and separately with Independent samples 't' test (Figure-1).

Table-1: Demographic data- age, weight, height and body mass index (BMI)

Demography	Sub grading	CLSP (Mean±SD) (n)	YLSP (Mean±SD) (n)	Independent Samples 't' test
Age	Total	52.96±5.9 (50)	53.44±6.4 (54)	0.69
	LV Moderate	53.26±5.8 (19)	53.17±7.6 (24)	0.78
	LV Severe	52.77±6.0 (31)	53.67±5.4 (30)	0.78
Weight	Total	65.72±8.4 (50)	68.33±8.0 (54)	0.11
	LV Moderate	65.89±9.4(19)	67.50±8.9 (24)	0.91
	LV Severe	65.61±7.9 (31)	69.00±7.3 (30)	0.5
Height	Total	163.56±5.5 (50)	164.46±6.3 (54)	0.44
	LV Moderate	165.68±4.0 (19)	164.83±5.3 (24)	0.03
	LV Severe	162.26±5.9 (31)	164.17±7.1 (30)	0.7
BMI	Total	24.52±2.6 (50)	25.31±3.1 (54)	0.17
	LV Moderate	24.00±2.9 (19)	24.79±2.8 (24)	0.28
	LV Severe	24.84±2.4 (31)	25.73±3.3 (30)	0.28
Echo	LV viability	n (%)	n (%)	
	Moderate	19 (44.2)	24 (55.8)	P value=0.50
	Severe	31 (50.8)	30 (49.2)	Chi value=0.44

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

	Group	n	Baseline (Mean±SD)	6th year (Mean±SD)	P value	d value
EF	CLSP	50	51.12±6.9	53.06±5.8	0.109	0.23
	YLSP	54	52.52±7.5	54.54±5.5	0.004**	0.41
	P value		0.33	0.19		

**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,

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.

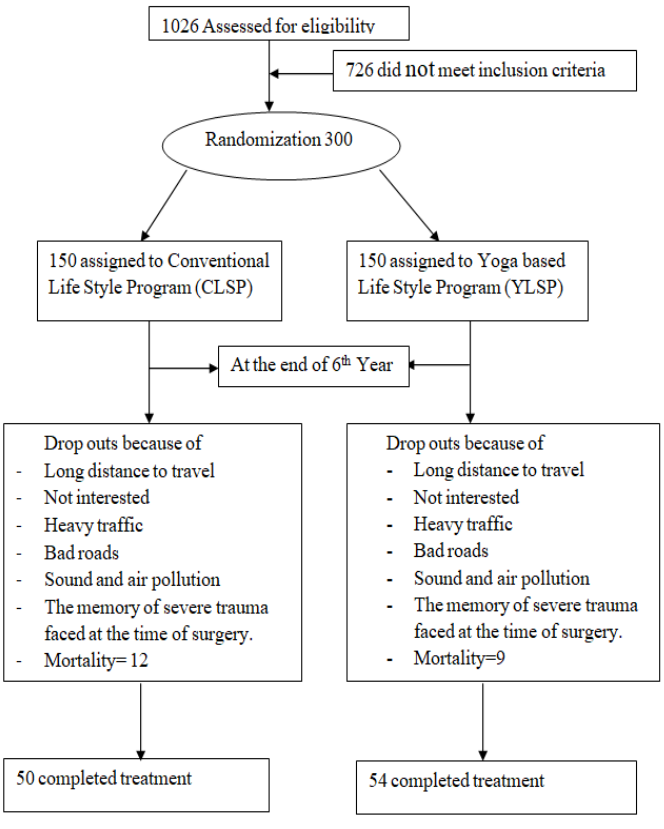


Figure 2. Consort chart

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=0.10, 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 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 Hypothalamo-Pituitary axis. (Evans, Cousins, Tsao, 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, Bijnens B3, 4, Myrmel 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, Sheikhvatan M, Karimi A, Ahmadi SH, Goodarzynejad 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 (Kofoed *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 because 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.

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