Yoga-Based Postoperative Cardiac Rehabilitation Program for Improving Quality of Life and Stress Levels: Fifth-Year Follow-up through a Randomized Controlled Trial

Abstract

Objectives: This study was aimed to assess the efficacy of yoga-based lifestyle program (YLSP) in improving quality of life (QOL) and stress levels in patients after 5 years of coronary artery bypass graft (CABG). Methodology: Three hundred patients posted for elective CABG in Narayana Hrudayalaya Super Speciality Hospital, Bengaluru, were randomized into two groups: YLSP and conventional lifestyle program (CLSP), and follow-up was done for 5 years. Intervention: In YLSP group, all practices of integrative approach of yoga therapy such as yama, niyama, asana, pranayama, and meditation were used as an add-on to conventional cardiac rehabilitation. The control group (CLSP) continued conventional cardiac rehabilitation only. Outcome Measures: World Health Organization (WHO)-QOL BREF Questionnaire, Perceived Stress Scale, Positive and Negative Affect Scale (PANAS), and Hospital Anxiety and Depression Scale (HADS) were assessed before surgery and at the end of the 5th year after CABG. As data were not normally distributed, Mann–Whitney U-test was used for between-group comparisons and Wilcoxon’s signed-rank test was used for within-group comparisons. Results: At the end of 5 years, mental health (P = 0.05), perceived stress (P = 0.01), and negative affect (NA) (P = 0.05) have shown significant improvements. WHO-QOL BREF score has shown improvements in physical health (P = 0.046), environmental health (P = 0.04), perceived stress (P = 0.001), and NA (P = 0.02) in YLSP than CLSP. Positive affect has significantly improved in CLSP than YLSP. Other domains of WHO-QOL-BREF, PANAS, and HADS did not reveal any significant between-group differences. Conclusion: Addition of long-term YLSP to conventional cardiac rehabilitation brings better improvements in QOL and reduction in stress levels at the end of 5 years after CABG.

Keywords: Cardiac rehabilitation, coronary artery bypass graft, coronary heart disease, meditation, yoga-based lifestyle program

Introduction

Quality of life (QOL) and stress levels after coronary artery bypass graft (CABG) surgery are important assessments to improvise health strategies in the management of coronary artery disease (CAD). There could be definitive complications of surgery such as the risk of failure, resulting in higher mortality rate at 5 years than 1 year after CABG, with 6.3% requirement of revascularization. QOL scores correlate with survival rates and both are affected adversely by the stress levels. The QOL improves at 5 years without any association with preoperative ejection fraction (EF), but this association was not found at 12 years of CABG.

Lifestyle behavior follow-up is poor in low-income countries, especially in young CABG patients, and after the first diagnosis of CAD, hence, it is important to develop a simple, effective, and low-cost strategies for the secondary prevention of further morbidity and mortality.

Worldwide, approximately 20% of people who receive primary health care have depression or anxiety disorders in general. Anxiety is associated with high risk of coronary heart disease (CHD) mortality in particular of prior depression status. The presence of anxiety and/or depression before surgery has the effect on cardiac rehabilitation outcomes after surgery, and both the factors are triggered and contributed using stress levels; hence, there is a need for early diagnosis and supportive therapeutics that involve mind–body interventions. There is need for

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interventions which target stress management\cite{14} and improve QOL, in particular after CABG.\cite{9}

Cognitive behavioral therapies and other mindfulness-based stress management programs can bring significant change in depression scores than usual care after CABG\cite{15} and also improve the physical and mental health.\cite{16,17} However, these programs require one-to-one sessions with a specialist and are time-consuming and costly. Yoga therapy is simple and cost-effective, it can be offered in groups, and people can be trained to practice regularly on their own with regular monitoring and follow-ups. Studies on yoga after CAD\cite{18} and CABG\cite{11,15} are available. Long-term follow-ups of relaxation-based lifestyle change studies in CAD with or without myocardial infarction (MI) have been reported.\cite{17,19,20}

In a previous randomized controlled study, we have reported the beneficial effects of yoga-based lifestyle program (YLSP) program as an add-on to conventional cardiac rehabilitation in improving left ventricular EF, psychological states, and various other risk factors at the end of 1 st the year as compared to ELSP through randomized controlled trial (RCT).\cite{21} The present study aims at looking at the effect of YLSP in QOL and stress levels after 5 years of CABG surgery.

**Methodology**

The results of a year-long follow-up of the EF and other measures have been reported in our earlier publication.\cite{21} At that time (2005–2007), all patients were advised to continue their home practices that were taught to them in person before discharge after CABG in the hospital.

**Subjects**

In the initial funded (Ministry of Health and Family Welfare, Central Ministry, New Delhi, India) project on the effect of YLSP, conducted between 2005 and 2007 at Narayana Hrudayalaya Institute of Cardiac Sciences (NHICSc), Bengaluru, we had recruited 300 participants who satisfied the selection criteria from a pool of 1026 screened patients who were posted for CABG (trial profile).

**Selection criteria**

The inclusion criteria for the study were (a) males posted for CABG with double or triple vessel disease, (b) EF above 30%, and (c) those residing within 200 km distance from the hospital. Those with other system diseases, those with EF <30%, those who were posted for valve repair in addition to CABG, and emergency CABG cases were excluded from the study [Table 1]. For the present study, we included all those cases who could give us the feedback; in the case of death, we had obtained the information from the relatives who received the follow-up phone calls or letter.

**Ethical clearance and informed consent**

The present follow-up study protocol was approved by the Ethical Committee of NHICSc and Swami Vivekananda Yoga Anusandhana Samasthana (SVYASA) University. Written informed consent was obtained at the time of recruitment for the RCT which had mentioned about the long-term follow-up.

**Procedure**

The present study reports the results of the 5 th-year follow-up of those who were recruited for the initial RCT between 2005 and 2007. For this follow-up study, the research team was in continuous contact with all the participants through phone calls and reminder letters. One of the research team members met the participant at these follow-up visits. All those who came for the follow-up went through a review session of yoga (experimental group) or exercise (control group) practice session for 1 h and gave their feedback on the current health status and completed the psychological questionnaires. The results of the follow-up investigations were reviewed by the cardiology team with suitable advice on changes in medication and lifestyle.

**Measurements**

- Perceived Stress Scale (PSS): It a self-reporting validated tool\cite{19,22} for assessing the perception of stress over the past 1 month,\cite{20,23} with the reliability of 0.85, and this can be used after CABG\cite{21}
- Positive and negative affect scale (PANAS): PANAS has four subscales, i.e., positive affect (PA), negative affect (NA), other positive, and other negative consisting of 10, 10, 4, and 6 items each with validity and reliability of 0.86–0.9 for PA and 0.84–0.87 for NA\cite{22,24}
- Hospital Anxiety and Depression Scale (HADS): A self-reported valid\cite{23,25} instrument designed to assess the anxiety and depression in nonpsychiatric population. This questionnaire consists of two subscales of seven items for anxiety and depression. The report will be based on the past 2 weeks on the scale of four ranging from 0 (“not at all”) to 3 (“very much”). The reliability was 0.85 for HADS and 0.79 and 0.87 for the two subscales (HADS-anxiety [HADS-A] and HADS-depression [HADS-D])\cite{24,26}
- QOL: World Health Organization (WHO) QOL-BREF has 26 questions developed by WHO. It is a scale that measures four domains such as physical (7 items), mental (6 items), social (3 items), and environmental health (8 items), which is perceived by the person. First and second questions related to “overall QOL” and “general health” facets are not included for scoring as per the user manual. The range of scores is 4–20 for each domain and scales in a positive direction (i.e., higher scores denotes higher QOL). The internal consistency is ranged from 0.66 to 0.87 (Cronbach’s alpha coefficient). This has good validity and test–retest reliability and is recommended for the use in health surveys and to assess the efficacy of any intervention at suitable intervals according to the study.\cite{25,27}
Intervention

Practices common to both groups

The present study interventions include different practices; pharmacotherapy, study material, and the cardiac rehabilitation program for 30 min by a physiotherapy expert were common to both the groups.

Experimental group (yoga-based lifestyle program)

Yoga starting with simple and safe practices suited to the stamina of participant is used. Integrative approach of yoga therapy-based yoga modules which are described in detail in our previous work[21] was used [Table 2]. Counseling on lifestyle modification includes concepts of Ashtanga yoga (Yama, Niyama) with the scientific background.

Control group (physiotherapy-based lifestyle program: Conventional lifestyle program)

Warm-up exercises including breathing exercises and some more physiotherapy-based exercises in different positions as per the stamina and those comparable with yoga asanas were administered [Table 2]. Counseling was given by the physician about the lifestyle modification.

Data analysis

SPSS version-20, Armonk NY: IBM Corp was used to analyze the data. Since the data were not normally distributed on Kolmogorov–Smirnov test, thus, nonparametric tests such as Wilcoxon’s signed-rank test and Mann–Whitney U-test (MWT) were used to compare the means within and between groups, respectively.

Results

Trial profile

The trial profile [Figure 1] represents the procedure of study from recruitment to 5th year after CABG. Three hundred individuals (150 in each group) who satisfied the selection criteria were recruited. Because of memories of trauma from CABG, mortality (two in conventional lifestyle program [CLSP], one in YLSP), long distance to travel to reach the hospital, and heavy traffic, we lost the follow-up of nearly 100 people in each group. Later, the imputation method was conducted to add the two missing items of each questionnaire. This happened both at baseline and 5-year data. More than two items were excluded totally from other questionnaires also. This gave the less sample size for further analysis. Total of 36 in control group and 37 in yoga group is the sample size in all questionnaires and at both times of data collection.

Table 1 shows the demographic details. There was no significant difference of sample size between the groups, age, gender, education, or socioeconomic status. All of them were married, were graduates/postgraduates, and were in middle/low socioeconomic status. Most of them had hypertension, diabetes, and/or obesity. There was no difference between the groups for other risk factors as well.

Table 1: Demographic data

| Categories                  | Groups | Chi-square test (P) |
|-----------------------------|--------|---------------------|
| Sample size                 | CLSP   | YLSP                |                  |
| Gender                      | Male   | Male                |                 |
| Age range (years)           | 35-65  | 35-65               | -                |
| Educational level (%)       | School | 25 (47.2)           | 28 (52.8)        | 2.04 (0.56) |
|                            | Under graduation | 47 (53.4) | 41 (46.6) | -    |
|                            | Graduation     | 36 (44.4)           | 45 (55.6)        |                 |
|                            | Postgraduation | 42 (53.8)           | 36 (46.2)        |                 |
| Religion (%)                | Hindu   | 138 (49.3)          | 142 (50.7)       | 0.85 (0.355) |
|                            | Others   | 12 (60)             | 8 (40)           |                 |
| Economic status (%)         | Upper class| 12 (44.4)           | 15 (55.6)        | 0.51 (0.77) |
|                            | Middle class| 91 (51.4)           | 86 (48.6)        |                 |
|                            | Lower class | 47 (49)             | 49 (51)          |                 |
| Angiogram report (%)       | Single vessel disease | 26 (61.9) | 16 (38.1) | 13.99 (0.003) |
|                            | Double vessel disease | 27 (37.5) | 45 (62.5) | -    |
|                            | Triple vessel disease | 95 (51.9) | 88 (48.1) |                 |
|                            | Myocardial infarction | 50 (66.7) | 25 (33.3) |                 |
| Associated problems (%)    | Diabetes mellitus | 74 (47.1)           | 83 (52.9)        | 2.12 (0.54) |
|                            | Hyper tension    | 91 (51.7)           | 85 (48.3)        |                 |
|                            | Obesity          | 41 (42.7)           | 55 (57.3)        |                 |
|                            | Others           | 5 (45.5)            | 6 (54.5)         |                 |
| Risk factors (%)           | Alcohol         | 18 (42.9)           | 24 (57.1)        | 1.19 (0.75) |
|                            | Family history   | 26 (43.3)           | 34 (56.7)        |                 |
|                            | Smoking          | 19 (42.2)           | 26 (57.8)        |                 |
|                            | Tobacco          | 21 (52.5)           | 19 (47.5)        |                 |
| Duration of coronary artery disease (year) (%) | <1  | 83 (47.4)           | 92 (52.6)        | 0.55 (0.75) |
|                            | 1-5             | 59 (50.4)           | 58 (49.6)        |                 |
|                            | 5-10            | 8 (42.1)            | 11 (57.9)        |                 |

CLSP = Conventional lifestyle program, YLSP = Yoga-based lifestyle program

World Health Organization quality of life-BREF

Table 3 shows the results of QOL and perceived stress levels at 5th year of CABG participants.

Total scores

Total WHO-QOL-BREF scores were nonsignificant change between groups after 5 years (P = 0.105). There were significant improvement within YLSP group (4.36%, P = 0.097) and nonsignificant change in CLSP group (−1.11%, P = 0.819) after 5 years.

Domain 1 (D1): Physical health

Physical health scores showed nonsignificant change between groups after 5 years (P = 0.167). There were significant improvement within YLSP group (7.27%,
Domain 2 (D2): Psychological

Mental health scores showed significant improvement between groups after 5 years \( (P = 0.058) \) with YLSP group showing better results than CLSP group. There was nonsignificant change in YLSP group (3.20%, \( P = 0.203 \)) and in CLSP group (−2.09%, \( P = 0.640 \)) after 5 years.

Domain 3 (D3): Social relationships

There was a nonsignificant improvement between the groups for the social interaction scores after 5 years \( (P = 0.141) \). There were nonsignificant improvement in YLSP group (−2.12%, \( P = 0.601 \)) and significant improvement in CLSP group (−7.4%, \( P = 0.098 \)) after 5 years.

Domain 4 (D4): Environment

Environmental health scores showed the nonsignificant change between groups after 5 years \( (P = 0.240) \). There were significant improvement within YLSP group (5.07%, \( P = 0.044 \)) and nonsignificant change in CLSP group (0.73%, \( P = 0.907 \)) after 5 years.

**Table 2: Intervention**

| Duration        | Conventional session details                                                                 | Yoga session details                  |
|-----------------|----------------------------------------------------------------------------------------------|--------------------------------------|
| Baseline        | Breathing practices                                                                            | DRT                                  |
|                 | Physiotherapy exercises for; wrist, back of hand, elbows, neck, back and legs                  | MSRT                                 |
| Until 5th year  | Additional physiotherapy exercises in standing position                                        | Yogaic breathing practices           |
|                 | Sit-ups, hip rotation, knee rotation, forward drill, backward drill, sideward drill, full arm rotation, free walking | Prasara Hasta Swasah - hands in and out breathing |
|                 | Sitting in a chair                                                                            | Utkasita Hasta Swasah - hands stretch breathing |
|                 | Ankle bending and toe bending                                                                  | Vyaghra Swasah - tiger breathing      |
|                 | Leg spread exercises with support-side ways, front and back                                   | Ekapada utanasana Swasah - straight leg raise breathing |
|                 | Supine rest                                                                                   |                                       |

DRT = Deep relaxation technique, MSRT = Mind sound resonance techniques, QRT = Quick relaxation technique

**Perceived stress scale**

Perceived stress scores were significantly reduced in the YLSP group as compared to CLSP group at the end of 5 years \( (P = 0.011) \). There was significant improvement...
Positive and negative affect scale

PA scores did not show significant difference between the groups after 5 years ($P = 0.323$). There were nonsignificant increase in PA in the YLSP group ($5.95\%, P = 0.364$) and significant improvement in the CLSP group ($11.82\%, P = 0.02$) after 5 years.

NA scores reveal significant improvement in the between-group differences after 5 years ($P = 0.05$). There were nonsignificant reduction of NA scores in YLSP group ($−7.3\%, P = 0.204$) and significant increase within CLSP group ($30.7\%, P = 0.003$) after 5 years.

Hospital anxiety and depression scale

No significant between-group differences were observed for either HADS-A or HADS-D score at the end of 5 years. Although the results were not significant in within-group comparisons, there was higher tendency for YLSP group to show the reduction in depression scores ($−2.14\%$ in YLSP group vs. $1.78\%$ in CLSP group).

Discussion

We observe that continuous practice of YLSP program as an add-on to conventional cardiac rehabilitation program leads to better improvement in the QOL and reduction of perceived stress as compared to physiotherapy-based lifestyle program in patients, 5 years after CABG. There was no significant difference between groups at the baseline.

To the best of our knowledge, there are no studies reporting 5-year follow-up on QOL after CABG. Studies show that surgical impacts are better for physical health and functional capacity of QOL after CABG, but the psychological domain of QOL remains unaffected.$^{[26,28]}$

Perceived stress scale

The present study showed significant improvement in PSS scores after 5 years in YLSP group. Lifestyle counseling can reduce the over weight, lipid levels, blood pressure and glucose imbalances in cardiac risk population.$^{[29]}$ It has been observed that lateralization of cerebral activity during stress may stimulate the heart asymmetrically, and this may lead to cardiac arrhythmias.$^{[30]}$ Previously, mindfulness-based practice was used in experienced meditators wherein better cortisol recovery was observed after social stress test. Recovery of stress after mindfulness meditation has been demonstrated to be due to regulation of histone deacetylases and associated inflammatory pathways. This reflects the probable therapeutic mechanism of action of mind–body therapies such as yoga, in stress-related disorders.$^{[27,29]}$ Previously, it was observed that intensive lifestyle counseling helped patients with cardiovascular risk factors, by reducing their body weight, blood pressure, lipid, and glucose levels.$^{[21,28,30]}$ In another study, aerobic exercises for 35 min and 35 min of walking were compared with...
stress management training for 16 weeks. It was observed that with its emphasis on emotion and behavior of person, stress management program lead to greater reduction in the general distress.[10,32] Worse physical health in terms of depression, osteoporosis, arthritis, cancer, prehospital problems, and poor mental health in terms of anxiety,[33] depression, and worse emotional score is more in elder patients after aortic valve replacement (AVR) with or without CABG.[34,35] The basic knowledge about the disease process and the steps to be taken after diagnosis also makes much difference in adherence to lifestyle program.[36,37] This may be the reason for nonsignificant improvements of the control group.

**Positive and negative affect scale - Positive affect**

It showed better nonsignificant improvement in CLSP group [Table 4]. This result is supported by a study showing association of self-care and PA scores after 1 year in chronic heart failure patients.[38,39] Circadian hyper amplitude tension and abnormal low diastolic BP have been associated with NAs.[38] PA scores correlated negatively with the tumor necrosis factors and interleukins in 79% men of 67 ± 9 years of age.[38,39]

**Positive and negative affect scale - Negative affect**

It showed significant increase in CLSP compared to YLSP [Table 4]. In contrast, previously, another study observed similar results at 9th year of follow-up of CHD patients after conventional rehabilitation which may be the reason for less QOL in CLSP.[1,18,40] Non-significant increase of PANAS-PA in YLSP supported by the reduction of PANAS-NA might increase the QOL after CABG.[39] CLSP group showed increased negative emotions may be because of the trigger of acute coronary syndrome with negative emotions such as events in workplace.[40] In a population-based study, cardiovascular disease did not affect the emotional well-being of the subjects but shown association of negative emotions with cardiogenic drugs at old age of about 84 years.[41] May the risk aversion[42] from surgery, future life expectations[43] at the time of assessment show the personality change over a period of 5 years after CABG. Anxiety and depression are common for CABG before and after the surgery.[44] Better QOL after CABG reduce the chance of depression.[45] Anxiety has much influence on cardiac adverse events than distress after 5 years of CABG.[2]

**Hospital anxiety and depression scale**

Nonsignificant changes of HADS-A and HADS-D scores happened after 5 years in both groups [Table 4]. Depression reduced with lifestyle program after 1 year in CHD patients with or without diabetes mellitus.[45] Depression but not anxiety is associated with the number of hospitalizations, hospital stay, and all-cause mortality in ischemic heart disease.[46] In CHD, the chance of HADS-D score is more and it will be much with the presence of risk factors like systolic blood pressure and body mass index.[47] High cholinergic neurotransmission associated with anxiety-like traits.[48] Anxiety may be associated with irregular growth hormone and melatonin rhythms which can be altered by basic lifestyle habits.[49] Minor events of daily life associates with adrenocortical activity.[50] Baseline psychological deviations between groups are because of the surgical trauma, and it can influence the outcomes of phase-2 rehabilitation.[12,13,51] One-quarter of cardiac arrest patients suffer from cognitive impairment that is dysfunction of medial temporal lobe and impaired short-term memory after 4 years of cardiac arrest.[52] Minor events of daily life associates with adrenocortical activity.[50]

**BREF-quality of life**

**Domain 1: Physical health (D1)**

There is significant improvement of physical health part of QOL in YLSP as in a study of add-on yoga in aerobic training.[53] The exercise capacity improved with home-based rehabilitation as in center based rehabilitation after MI[53] as the improvements of the CLSP group of the present study. Cardiac resynchronization therapy improves physical health after 4 years of CABG or AVR.[54]

**Domain 2: Psychological (D2)**

The present study showed nonsignificant improvement of mental health in YLSP as the supportive atmosphere, caring relationship, diet, and lifestyle change led to physiological changes such as reduction of anxiety, depression, and arrhythmia as in atrial fibrillation patients.[55] Both the functional capacity and the overall well-being improved paralelly after 2 years of heart transplantation with the possibility of comparing themselves with healthy individuals than patients.[55]

**Domain 3: Social relationships (D3)**

Non-significant improvement in CLSP resembles the conventional rehabilitation program which reduced the resting heart rate and increases duration of exercises and peak oxygen consumption and overall QOL after CABG.[56,57] Conventional rehabilitation phase-3 along with relaxation technique has shown better QOL than individual techniques in cardiac syndrome.[58] Generalization of treatment after longterm follow up will improves the social functioning.[59]

**Domain 4: Environment (D4)**

Significant improvement in YLSP after 5 years has similarities with previous study where improvements are because of better coping ability if they are married, living with family and the children were employed.[60] Previous regular leisure time activities prevent the suffering after CABG.[41] Therapeutic lifestyle may need to be a central focus of mental, medical, and public health.[62]
Total scores

Non-significant improvement of total QOL was observed in YLSP after 5 years. Low-intensity exercises can improve heart rate and functional capacity of CABG patients who have low- and moderate-risk factors.[63] Aerobic training and yoga improve the muscle strength, 6-min walk test distance,[64] which could be the base for overall improvement of health-related QOL.[60]

Psycho-biological mechanisms

The present study showed that perceived stress, PA, NA, anxiety, and depression in day-to-day life are the initial step of physiological disturbance of the body. There is significant correlation found between general knowledge about the CHD risk factors and ability to follow lifestyle changes and medication.[65] Lateralization of cerebral activity during emotional stress may stimulate the heart asymmetrically and develop cardiac arrhythmias showing the need for meditation techniques.[29,31] Yoga is not a few postures but a holistic lifestyle which promotes health at physical, mental, emotional, and spiritual levels,[66,67] with a component of stretching, physical postures, breath control, concentration techniques which improve organ and immune function.[68] The scientific backgrounds of physiological changes have well documented in conventional rehabilitation research and can be indicative to yoga programs as well.[68,69]

Autonomic nervous system dysregulation leads to depression after CABG.[70,71]

Limitations and future plans

Follow-up was poor even with 200 km of distance. Lack of interest from the subjects for follow-up after getting better in health was a major reason for high attrition rate. Risk factor analysis, complications, and hospitalization would have helped know the lifestyle better. We could not include the patients who wanted to change to experimental group to reach the health than the completion of work. All psychological parameters measured to ensure the role of mind in health maintenance but could not bring the cardiac measures to prove in a quantitative way.

As our treatment is home-based and self-paced program, which proves that the solution is at door step. This works for high-risk population (after 5 years of CABG surgery). With all boundaries, we could get some samples from both groups for further study which ensures the interest of participants in continuation of program. Response to the phone calls and visiting at review times make sure about the interest and comfort toward the intervention. Hence, integration of physical exercises well known as conventional rehabilitation and the traditional lifestyle well known as yoga benefited the CABG patients. Patients use to demonstrate the asked practice and were replying yes for regularity. However, this was not documented. All psychological parameters measured to ensure the role of mind in health maintenance.

Conclusion

Addition of long-term YLSP to conventional cardiac rehabilitation brings better improvement in QOL and reduction in stress levels at the end of 5 years after CABG. However, there are a large number of patients which have been lost to follow-up in the present study; hence, larger studies with better follow-up and cardiac end points are needed.

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Conflicts of interest

There are no conflicts of interest.

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