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A Study to Evaluate the Hemodynamic Effects of Swiss Ball Exercises in Post Operative Coronary Artery Bypass Graft Patients

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Abstract: ***Background**: Swiss ball exercises for post - operative CABG patients, which are not, performed on large number of population the cardiovascular effect of exercises that involves coordination, stabilization, thoracic expansion and lung expansion and arm mobility exercises therefore, the study focused on evaluation of the hemodynamic effect of Swiss ball exercises on the cardiovascular system in post CABG Patients. **Objective Of The Study**: The patients with coronary artery bypass graft patients can be early mobilize by Swiss ball exercises. The aim of the study is to investigate the hemodynamic effects of the treatment. We aim at assessing cardiovascular system. **Design**: Convenient random sampling. **Subjects**: Data was collected from Geetanjali Medical College and Hospital; Cardio Thoracic Vascular Surgery Intense Care Unit. **Methodology**: This study includes 124 subjects both male and female of age 45 to 75 years who were eligible as per the inclusion criteria were divided into two groups - Group A (Swiss ball exercise individuals=62 subjects) and Group B (conventional exercises individuals= 62 subjects). Pre - participation subjective data along with consent forms were given to subjects to fulfill criteria for selection. Group "A" subject performed Swiss ball exercises and Group "B" subject perform conventional exercises from post - operative day 3 thrice a day. Heart Rate and Blood Pressure (Systolic and Diastolic BP) were recorded pre and post intervention each alternative day. Heart Rate was measured by manual palpatory method and Blood Pressure by Sphygmomanometer and secondary outcomes are respiratory rate and saturation oxygen. **Results**: Results showed that there was a significant difference in HR; SBP; DBP during pre - exercise session and HR, SBP and DBP were significantly higher during post exercise session of group A and group B. Although, Group A (Swiss ball individuals) experienced more cardiovascular demand as increased but the intervention has cardiovascular effects on GROUP B (conventional individual) HR value 80.95+5 beat per mint (on day 4^{th} $p<0.001$, day 6^{th} $p<0.001$), SBP value 138+5mmHg (on day 4^{th} $p<0.001$, day 6^{th} $p<0.001$), DBP value 75+5 mmHg (on day 4^{th} $p<0.20$, on day 6^{th} $p<0.25$). **Conclusion**: Swiss ball exercises have effective cardiovascular effects on post - operative CABG patients. This intervention may include routine care in CABG patients.*

Keywords: CABG, Swiss ball, heart rate, blood pressure, cardiac physiotherapy

1. Introduction

Coronary artery disease is caused by an atherosclerotic plaque that narrows the internal lumen of the coronary artery. This lesion decreases coronary arterial blood flow and oxygen supply to the myocardium and causes several symptoms such as chest pain, dyspnea, syncope, sometimes pulmonary edema. The low blood flow through the coronary artery territory cannot increase and support the increasing daily - life effort capacity.

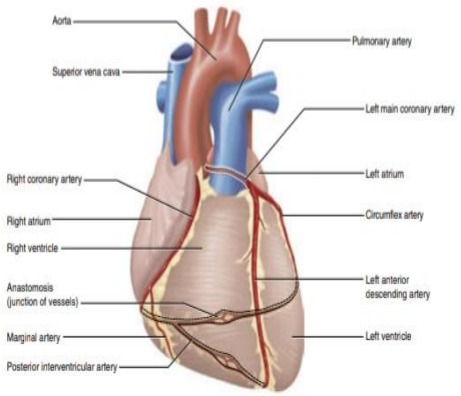


Figure 1.1: The coronary circulation illustrating the right and left coronary arteries and their major branches.

According to the world health organization, around 17.9 million people die annually due to cardiovascular disease worldwide, with an estimated 23 million death by year 2030. Coronary artery disease is the leading cause of cardiovascular morbidity and mortality worldwide. The burden of coronary artery disease in India is rising remarkably. The national commission on macroeconomics and health estimated about 359 lakh coronary artery disease cases in 2005 that has been projected to raise up to 615 lakhs in 2015, with the corresponding loss of the national income of approximately 237 billion used in India.

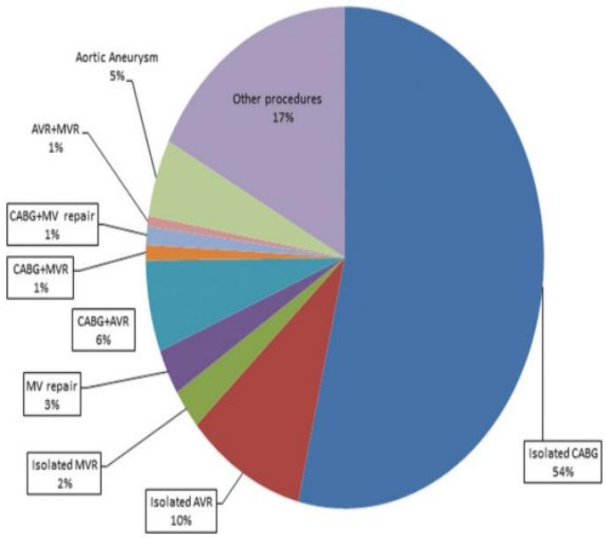


Figure 1.3: Relative distribution of cardiac operation by procedure type for calendar year 2016.

Coronary artery that accounted for less than 10% of all cardiac surgeries in 1980, in 2006 accounts for more than 60%and every year 25000 coronary artery bypass operations are being carried out in India.

Cardiopulmonary bypass is used to support the circulation in most operations to replace these diseased arteries. Narrowed sections of the main coronary arteries are bypassed by grafting a blood vessel between the aorta and a point in the artery beyond the narrowed or blocked area. Multiple grafts are often used for multiple athermatous lesions. For many years a section of vein removed from the leg was used for this, but increasingly the two internal mammary arteries (arteries that run down the inside of the chest wall) are also used. The internal mammary arteries are less likely than vein grafts to narrow over time. However, since there are only two internal mammary arteries many patients have a mixture of vein grafts and an internal mammary graft. The principle uses of coronary artery bypass grafts may be to relieve angina that is resistant to other forms of treatment and/or to prolong a person's life.

Studies of long ago recovery after critical illness demonstrate that some patients experience profound and prolonged neuromuscular dysfunction. Muscle weakness and wasting and nerve injury or damage resulting in intensive care unit - acquired weakness (icuaw) appears to start within the first few days of critical illness. As such, interventions that reduce intense care unit - acquired weakness and improve recovery after critical illness is of major importance to public health.

Physical therapy conducted by the hospital staff and the standard rehabilitation protocol was performed. In this protocol, on the 3th postoperative day, they include early mobilization, assisted and active exercises for upper and lower limbs, and progressive ambulation, positioning, incentive spirometer, expiratory positive airway pressure, deep breathing exercises, respiratory muscle training, coughing support.

Cardiac output is equal to heart rate multiplied by stroke volume. Most of the increase in cardiac output in exercise is associated with an increase in heart rate. Cardiac output increases with the intensity of exercise. Hemodynamic changes may get affected due to age, body build, diabetes, hyperlipidemia, hypertension, smoking.

ACC/AHA Recommendations for Coronary Artery Bypass Graft Surgery state that cardiac rehabilitation should be offered to all eligible patients after CABG.

Exercise is a major component for patients with coronary artery diseases. Cardiac rehabilitation usually begins during hospitalization (phase 1 inpatient), followed by a supervised outpatient program lasting 3 - 6 months (phase ii), and continuing in a lifetime maintenance stage in a minimally supervised or unsupervised setting (phase iii).

Coronary artery bypass surgery should perform aerobic exercise 3 - 5 times per week and 20 - 60 minutes for O_2 peak. Strength training is suggested to each session, at the intensity of 40 - 80% of volume performs 2 - 3 times per week at the intensity of 40 - 50% of maximal voluntary contraction with 10 - 15 repetitions.

The use of the Swiss ball to unload the muscles and thus provide a more moderate exercise environment the potential of helping the muscles regain power and endurance without creating excessive chemical imbalance.

There are at least four functions associated with the reticular formation

1) The ascending activating system of the reticular formation is the physiological basis for the levels of consciousness.
2) The reticular formation modulates segmental stretch reflexes and muscle tone.
3) The reticular formation is involved in the control of breathing and cardiac function.
4) Reticulo - spinal pathways modulate the sense of pain.

Swiss ball neuromuscular effect -

a) Kinaesthetic Awareness – Awareness of body parts is relation to each other.
b) Visually activation –actually seeing the object visually activates a motor program vision is thus very involved in anticipatory behaviour.
c) Head, eye and extremity coordination improvement.

The limbic system involves behaviour and resulting emotional needs. It regulate the internal environment and important for the control of homeostasis. Advantages to use Swiss ball in ICU early mobilization is performed in the upright position, that is the physiologic position whenever possible, to optimize the effects of being upright on central and peripheral hemodynamic and fluid shifts. Thus mobilization is prescribed to elicit both a gravitational stimulus and an exercise stimulus.

2. Aims and Objectives

Primary objective

1) To evaluate the hemodynamic effects of conventional physiotherapy in postoperative cardiac surgery patients.
2) To evaluate the hemodynamic effects of Swiss ball exercises in postoperative cardiac surgery patients.
3) To compare the hemodynamic effects of conventional chest physiotherapy with Swiss ball exercises and conventional physiotherapy in postoperative cardiac surgery patients.

Secondary objective

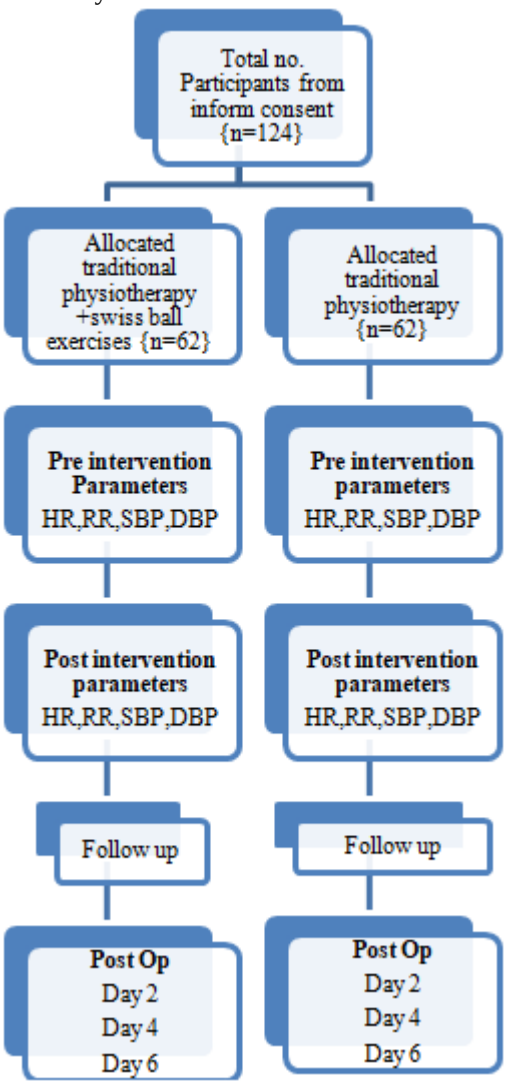
1) To evaluate adverse effect of Swiss ball exercises in postoperative cardiac surgery patients

3. Materials & Methodology

A comparative study design was identified as appropriate to carry out a study to evaluate the hemodynamic effects of Swiss ball exercises in postoperative coronary artery bypass graft patients. A sample of 124 individuals were taken from Geetanjali Medical College and Hospital; Cardio Thoracic Vascular Surgery Intense Care Unit which are eligible as per inclusion and exclusion criteria. . A total of 124 individuals both males and females were selected for the study. A convenient random sampling technique is used for data collection.62 subjects. (In each group)

Inclusion Criteria:
Age group: - >18 years, Gender: - both male and female, Hemodynamically stable, Patient with CABG, More than 40 % LVEF

Exclusion Criteria:
Those who are not fulfilling the criteria, Those who refuse for the consent form, Other Cardiac surgery (except CABG), Pre - existing Respiratory condition (COPD, asthmatic,), Patient those who are on ventilator, Unstable angina pectoris, Renal complications, Liver pathology, Congestive heart failure (CHF), Ventricular or dissecting aneurysm, Ventricular tachycardia.



Flow Chart: Enrollment and Follow up Chart

Exercise Protocol for coronary artery bypass graft patients

1) Warm - up (10 mints.)
a) Breathing exercises - 10 repetitions (deep breathing exercise, inspiration hold)
b) Spirometer – 5 repetitions (inspiration and expiration)
c) Ankle toe movements 10 repetitions
d) Wrist pump movements 10 repetitions

2) Workout (20 mints)
(A) Swiss ball exercises for group A – 5 repetitions
a) Ankle toe movement with lower limb elevation in supine or sitting.
b) Shoulder flexion –extension with breathing control
c) Posterior support for anterior basal expansion.
d) Relaxed shoulder breathing control
e) Side rolling lateral basal expansion
f) Bed side sitting knee movement
g) Shoulder movement with chair sitting
h) Shoulder movement with standing

(B) Conventional exercises for group B – 5 Repetitions
a) Chest expansion exercises
b) Chest mobility exercises
c) Walking with support (2 round)

3) According to patient condition
a) Force expiratory techniques (huffing and coughing) (3 to 5 repetition)
b) Postural drainage (vibration and percussion)

4) Cool down (10 mints)
a) Relaxation position (on day 3 in supine and on day 5 in sitting)
b) Deep breathing exercise

Data Recording and Tabulation:
The values of all the parameters of the session were recording accurately in the printed data collection sheet. The collected data was edited, coded and a master chart was prepared for the statistical analysis.

Statistical Analysis:
Descriptive statistics for comparison between pre and post operative score including means and standard deviations were calculated.

Statistically the characteristics of score and the results were compared using independent sample t test and paired t test. A level of probability at 0.01 and 0.05 levels was assumed to draw significance.

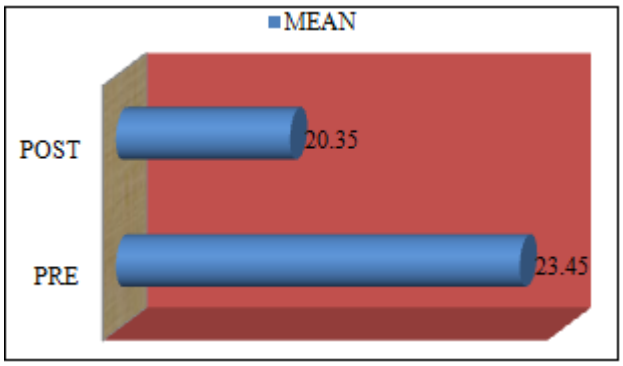
4. Result

Table 6.1: Age and Gender Wise Distribution in percentage of sample

Gender	40 - 50	50 - 60	60 - 70	≥80	Total number out of (124)	In present %
Male	10	37	43	1	91	73.40%
Female	4	20	8	1	33	26.6%
total	14	57	51	2	124	100%

Table 6.2: Pre and post exercises Mean score of respiratory rate in Swiss ball exercises.

Variables	Mean	SD	t	p
PRE	23.45	3.814	5.2016	0.00
POST	20.35	2.734		

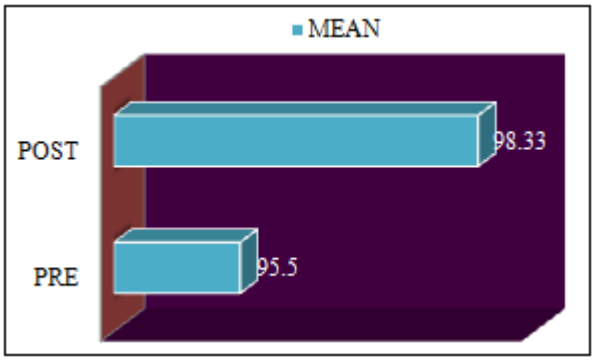


Graph 6.2: Pre and post exercises Mean score of respiratory rate in Swiss ball exercises.

Interpretation: (p<0.001) by conventional criteria this difference is consider to be extremely statistically significant.

Table 6.3: Pre and post exercises Mean score of oxygen saturation in Swiss ball exercises

	Mean	SD	t	p
Pre	95.5	2.762	8.3073	0.001
Post	98.33	0.676		

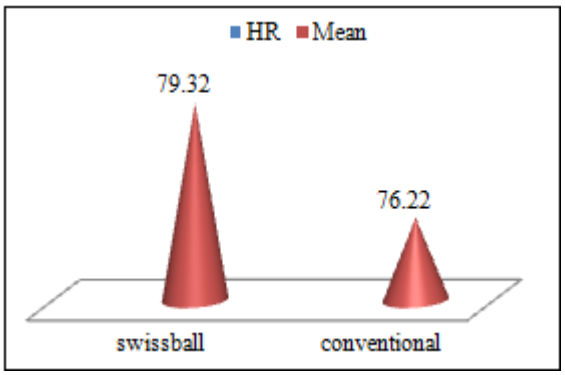


Graph 6.3: Pre and post Mean exercises score of oxygen saturation in Swiss ball exercises

Interpretation: (p<0.001) by conventional criteria this difference is consider to be extremely statistically significant. Comparison of pre and post mean SPO_2 shown that there is significant improvement in SPO_2 in patients. (P<0.001)

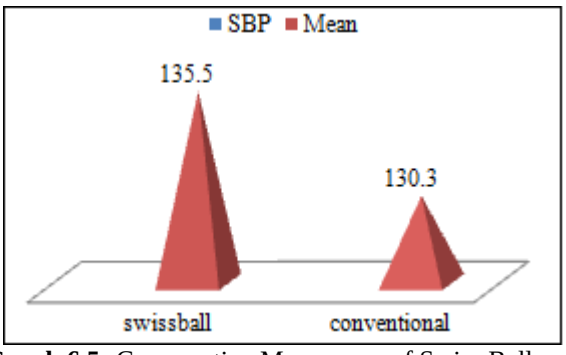
Table 6.4: Comparative Mean, Sd, t score And P Value of Swiss Ball And Conventional Exercises.

Variables	swiss ball	conventional	t	p
HR				
Mean	79.32	76.22	2.079	0.039
Sd	8.2	8.4		
SBP				
Mean	135.5	130.3	2.506	0.013
SD	11.4	11.7		
DBP				
Mean	82.43	77.84	2.284	0.0241
SD	12	10.31		



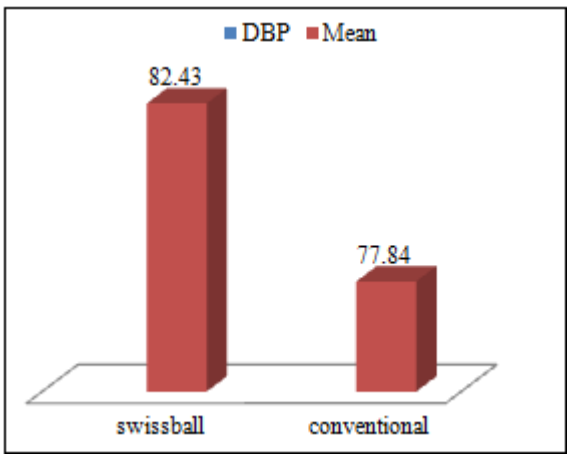
Graph 6.4: Comparative Mean score of Swiss Ball and Conventional Exercises (Heart Rate)

Interpretation: p value of HR (p<0.001) by conventional criteria, this difference is consider to be statistically significant.



Graph 6.5: Comparative Mean score of Swiss Ball and Conventional Exercises (Systolic Blood Pressure)

Interpretation: p value of SBP (p<0.001) by conventional criteria, this difference is consider to be extremely statistically significant.



Graph 6.6: Comparative Mean score of Swiss Ball and Conventional Exercises (Diastolic Blood Pressure)

Interpretation: p value of DBP (p<0.001) by conventional criteria, this difference is consider to be extremely statistically significant.

5. Results

Results showed that there was a significant difference in HR; SBP; DBP during pre - exercise session and HR, SBP

and DBP were significantly higher during post exercise session of group A and group B.

Secondary parameters are in Table no.6.2 showing pre and post scores of respiratory rate in Swiss ball exercises analysis that it is extremely statistically significant. Table 6.3 indicate that pre and post operative score of spo2 in Swiss ball exercises shows that there is significant improvement in spo_2 in sample population.

Table 6.4 which represents comparative study of mean, sd score and p value of Swiss ball exercises and conventional exercises shows that there is greater significance in hemodynamic parameters of Swiss ball exercise in comparison to conventional exercises which have less significant difference in hemodynamic parameters

Although, Group A (Swiss ball individuals) experienced more cardiovascular demand increased then the intervention has cardiovascular effects on GROUP B (conventional individual)

In Swiss ball exercises HR value 80.95+5 beat per mints (on day 4^{th} $p<0.001$, day 6^{th} $p<0.001$), SBP value 138+5mmHg (on day 4^{th} $p<0.001$, day 6^{th} $p<0.001$), DBP value 75+5 mmHg (on day 4^{th} $p<0.20$, on day 6^{th} $p<0.25$).

6. Discussion

In the aim of the study was to investigate the hemodynamic effects of Swiss ball exercises and early mobilization for reduce the incidence of weakness and atelectasis and improve oxygenation in patient of coronary artery bypass graft.

Mean age of volunteers range from 45 to 75 the main outcome was SBP DBP and HR secondary outcomes are RR and spo2 pre and post test measurement was performed at preoperative and post operative day 2, 4and 6 volunteer group were diagnosed with LVEF ≥40 % (left ventricular ejection fraction) frequency of receiving Swiss ball exercises program take 20 minutes, thrice a day from post operative day 3 to day 6.

The result show that increase in systolic blood pressure significantly that associated with present study the use of Swiss ball exercises this frequency of exercise refers to the aerobic exercise pattern experimental result shows statistcally significant changes in HR and SBP used in experiment.

The study found the exercise with ball has increase systolic blood pressure and stable diastolic blood pressure with systolic pressure. Increased as high as (10+5mmhg) and decrease (10+5mmhg) explain that the acute setting that aerobic exercises to higher systolic blood pressure increase by 5 to 15mmHg the result of this study explain by improvement in cardiorespiratory fitness brought about by ball exercises which is formal aerobic exercise that both physical and emotional benefits.

In further studies they conclude this Swiss ball is more Effective than resistance exercises in acute setting. Exercise are accompanied by proprioceptive activity Postural stability is achieved. Through the co activation muscles of trunk & also improves Coordination.

During my internship, I observe that post operative CABG patients develop upper limb atrophy after sternotomy. The reason behind atrophy is that patients can't perform upper limb movement due to pain, stiffness, fear of tearing of stitches etc. There are researches on lower limb which used ergometer or shuttle run exercises to regain the strength or prevent atrophy. These methods are time consuming and not cost effective.

Hence, I choose Swiss ball to target musculoskeletal system in post CABG patients. The use of Swiss ball requires availability of the equipment (cost of purchase and maintenance Sanitizations), care for transportation (inflate or deflate) and adaptation to the bed and the presence of physiotherapist to ensure safety during the activity This method is less time consuming and cost effective. Moreover it is easily available and easy to perform.

Swiss ball is used as movement stimuli or motion stimuli in patients with leukemia, COPD etc.

There has not been any detail study which uses Swiss ball as an exercise tool in intensive care unit for rehabilitation purpose.

7. Limitations of the Study

1) The information on the safety and injury risk of the training protocol in the general population was not known.
2) Influence of drug, climate and psychological factors cannot be controlled.
3) Only subjects with coronary artery bypass graft were taken for the study.
4) Psychological status was not evaluated.

8. Conclusion

This were study demonstrated that group "A" effective in promoting increased SBP & HR in Hemodynamic effects in CABG patient who underwent physical therapy rehabilitation.

Swiss ball exercises show more stability in Hemodynamic effect. As per result Swiss ball is safer exercise as well as effective treatment to prevent atrophy, maintain peripheral circulation mobility in limbs this intervention could be the part of routine care in CABG.