

Immediate hemodynamic response of light isometric exercise in early phase of cardiac rehabilitation on post operative valve replacement patients

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Abstract

Introduction: The resistance or isometric exercise is contraindicated in the early phase of cardiac rehabilitation, but normal daily activities of patients after cardiac surgery includes light isometric exercise, such as lifting and carrying loads that require 20-30% of a maximal voluntary contraction (MVC). Thus, this study is design to evaluate the hemodynamic response of light isometric exercise in postoperative valve replacement patients.

Method: This study was carried out with seven post operative valve replacement subjects with the mean age ± 39.71 at CTVS unit. After thorough assessment and consent was signed. The light isometric exercise with 30% of MVC was performed and hemodynamic measures were taken in rest, during 2nd min of exercise and immediately after termination of exercise.

Result: Wilcoxon Signed Ranks Test was applied to compare the hemodynamic variables in rest, during 2nd min. of exercise and immediately after termination of exercise. The result shows statistically nonsignificant values.

Conclusion: As the comparison was done between the hemodynamic at rest, during 2nd min of exercise and immediately after cessation of exercise in the post-operative valve replacement patients, the results show no significant changes in the variables. Although, practically these variables were slightly increasing immediately during the contraction but not shows any harmful effect in the patient. The Valsalva maneuver was avoided by instructing the patient to continuously take deep breathing during the procedure. Sternum stability was also ensuring by applying the sternal binder. Thus, this study strongly report that the light isometric exercise with ensuring the safety is not harmful to the patients even in the early phase of cardiac rehabilitation.

Key words: isometric exercise, MVC, valve replacement surgery, early phase of cardiac rehabilitation.

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INTRODUCTION: Resistance exercise training has become an integral part of cardiopulmonary Rehabilitation programmes.¹

Traditionally, the exercise regimens utilized in the early trials were primarily intended for strength development and muscular hypertrophy, resistance exercise was not recommended as a suitable intervention for the prevention of cardiovascular disease risk factors.

Further investigation has demonstrated that resistance training with a lower load can positively impact risk factors, including low levels of insulin and plasma glucose, elevated levels of high-density lipoprotein cholesterol, and decreased resting blood pressure, all without compromising cardiovascular function in healthy individuals.^{2,3} It is well known that in healthy individuals, prolonged isometric contraction results in a significant rise in systolic, mean, and diastolic blood pressure. This elevation in blood pressure showed little change in stroke volume or systemic vascular resistance and was mainly caused by an increase in cardiac output correlated with an increase in heart rate; however, this is not always the case for all types of loads.^{5,6}

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The amount of muscle mass used, the isometric component's magnitude, and the load intensity (measured in percentage of maximum voluntary contraction; MVC) all affect the real blood pressure response to resistance training. The intensity is not high enough to cause the maximum blood pressure reactions at an MVC below 70%. When performing the Valsalva maneuver during resistance exercise, there is a more noticeable increase in blood pressure. Peak blood pressure can cause arterial rupture, while a decrease in cardiac output lowers the perfusion of the coronary arteries. Unwanted changes in the disease state's hemodynamics may arise when cardiovascular stress is assessed during static exercise. These include dysrhythmia, an increase in systolic blood pressure, an increase in stroke volume, a decrease in cardiac output, and an ejection fraction (EF).^[8]

Exercise induced problems should be kept to minimum by patient-specific exercise prescription, correct examination, supervision and by precautions like avoid valsalva maneuver.^{6,9} A reliable indicator of upper limb small peripheral muscle strength is the dynamometer hand grip

strength measurement. Respiratory issues following heart surgery continue to be a major source of morbidity, which can lengthen hospital stays and raise expenses.¹⁴ Additional complications include decreased cardiac function, which will restrict the amount of exercise possible, loss of skeletal muscle mass, which is also linked to persistent muscle weakness, and increased myocardial oxygen consumption.¹³ For many patients with acquired valve disease, heart valve replacement, a kind of cardiac surgery, is the preferred course of treatment. Improvements in pulmonary hemodynamics typically occur in the initial weeks following surgery.^{15,16,17} Physicians recommendations regarding the degree of activity following a myocardial infarction (MI), percutaneous coronary intervention, and any cardiac surgery are often confusing. Most people are told not to lift anything heavier than five pounds. The guidelines not only recommend weight amounts below what patients require for even the most basic activities of daily living, but they also unnecessarily postpone resistance training. Scientific evidence does not corroborate the conventional wisdom that resistance training is detrimental to cardiac patients. It's critical to keep moving after heart surgery to prevent physiologic atrophy and decline. Resistance training increases the strength and endurance of skeletal muscles, which is necessary for a safe return to daily activities.¹⁸ It is time to change cardiac rehabilitation guidelines and recommendations to take into account the physical and physiologic limitations of patients for resistance exercises, as we do for dynamic exercises.⁹ The present study is design to assess the effect of isometric in the hemodynamics of post cardiac patients in the early phase of recovery and it is done by ensuring the safety through risk assessment, under supervision and using light intensity of isometric exercises in small muscle group. Rather than focusing on weight

usage, cardiac rehabilitation specialists should monitor symptoms and focus on activities that patients can perform safely. This study will therefore take exercise program customization a step further by encouraging increased fitness levels and an early return to daily living activities.

METHODOLOGY: The study design was observational, comparative study and formulated in CTVS unit of Himalayan Institute Hospital Trust, Jollygrant, Dehradun, U.K. the selection criteria includes: Post-operative valve replacement patients, Both genders, Age 30-70, Uneventful surgery, Subjects with no inotropic and chronotropic support and Exclusion Criteria - Increase of body weight within 24hours more than 1 kg, Significant exercise induce arrhythmias, Severe pulmonary hypertension, BP decrease of >20mmg during exercise testing, Complex ventricular arrhythmias, egPVC, 3r degree AV block, Systemic illness or fever, Pericarditis, endocarditis or myocarditis, LVEF<40%, Orthopedic conditions related to upper limb, like- upper limb amputation, carpal tunnel syndrome, erbs paralysis, etc.,

Neurological disorder like- CVA, myasthenia graves, etc. Outcomes Measures were- 1. ECG – Heart rate. 2. Invasive arterial catheter- Systolic blood pressure, Diastolic blood pressure, Mean blood pressure, 3. Thermodilution method – Cardiac output, Stroke volume, Systemic vascular resistance, 4. Pulmonary artery catheter- Pulmonary artery catheter

INSTRUMENTATION:

Hand grip dynamometer- (Baseline, 200# Hydraulic Hand Dynamometer, 12-0103), Cardiac Monitor - (PhilipsMP40), Swan Ganz Catheter - (Edward Life Science, refno.8314775), Arterial Transducer - (iPeX pressure monitoring kit, Ref. BKT 16.4).

PROCEDURE: Nine sample populations were selected in theCTVS unit. Out of nine, one patient wasexcluded from the study due to resting PVC in post operative phase. One patient was not successfully complete the 5 min. procedure and subject feels fatigue after 3min. of exercise. Thus, the seven sample size were remain. A consent form will be signed prior to start the procedure. According to the American Society of Hand Therapy, each patient was instructed to squeeze a handgrip dynamometer (basis hydraulic dynamometer) at the greatest force he could muster for a single instant. The maximum voluntary contraction (MVC) of his forearm muscles was estimated using this measurement. This procedure was repeat for 3 times afterone minute of rest periods. Second reading was taken as MVC. On POD 2nd the procedure of isometric exercises was performed by hand grip dynamometer before any oral administration of inotocic and chronotopic drug. According to the American Society of Hand Therapy, each patient was instructed to squeeze a handgrip dynamometer (basis hydraulic

dynamometer) at the greatest force he could muster for a single instant. The maximum voluntary contraction (MVC) of his forearm muscles was estimated using this measurement. This procedure was continuing for 5 minutes. Patients were asked to avoidundue pain. To avoid valsalva maneuver patients was ask to breath continue. Measures of outcomes were: cardiac output, stroke volume, heart rate, diastolic and diastolic blood pressure, mean blood pressure, and cardiac output. Systemic vascular resistance, mean pulmonary artery pressure, diastolic pulmonary artery pressure, and systolic pulmonary artery pressure.

These outcomes were taken by ECG leads connected to cardiac monitor, invasive arterial blood pressure and thermodilution method at the period of resting, during 2nd minutes of exercise and after 5 min., immediately after termination of exercise.

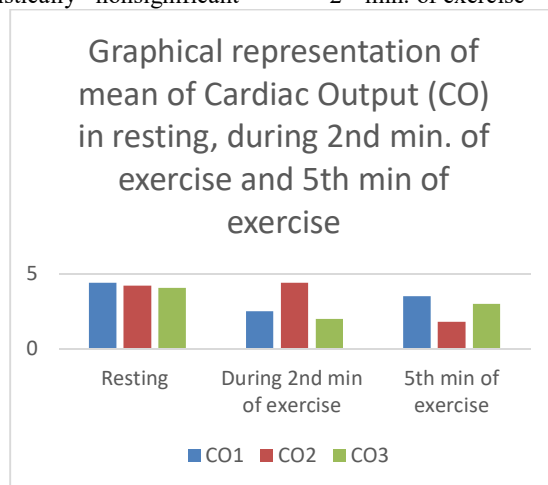
DATA ANALYSIS: Data obtained was subjected to statistical analysis using following test of significance- Comparison of hemodynamic responses within the subjects at rest and during 2nd minute and, at rest and immediately after cessation ofisometric maneuver by Wilcoxon Signed Ranks Test. IBM SPSS version 20

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was used for analysis. A significance threshold of $P < 0.05$ was used.

RESULT: result shows statistically nonsignificant

value when p value was set in $< 0.05\%$. Graphical representation of mean of Cardiac output in resting and during 2nd min. of exercise-



DISCUSSION and CONCLUSION:

Traditionally, the isometric exercise is not recommended in the early phase of cardiac rehabilitation due to undesirable changes in the hemodynamics of the patient. But these changes are proportionate to the intensity of the MVC, duration of contraction and size of the muscle mass involved during the contraction. As the patient does light isometric activity in some extent in the early phase of cardiac rehabilitation to fulfil their daily requirement, it will not create deleterious effect on the patients. Since the hemodynamics of the post-operative valve replacement patients were compared at rest, during the second minute of exercise, and right after exercise cessation, no statistically significant differences were found. Although, practically these variables were increased immediately during the contraction but not shows any harmful effect in the patient. The Valsalva maneuver was avoided by instructing the patient to continuously take deep breathing during the procedure. Sternal stability was also ensured by applying the sternal binder. Thus, we strongly report that the light isometric exercise with ensuring the safety is not harmful to the patients even in the early phase of cardiac rehabilitation.

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