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The effect of selected positions on rate pressure products of the postmyocardial infarction patient

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the Postmyocardial Infarction Patient

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The Effect of Selected Positions

on Rate Pressure Products of

the Postmyocardial Infarction Patient

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Dedication

To my husband, Rocco, who continues to support my educational pursuits.

To my parents, who emphasized the importance of education.

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Abstract

Position change following a myocardial infarction (MI) is warranted when the damaged ventricle is hemodynamically able to support cardiovascular changes that occur from position change and when the coronary arteries can supply oxygen to meet the increased metabolic demands of the myocardium. The nurse is responsible for gauging the patient's cardiac response during various positions. The purpose of the study was to determine the effect of four patient positions on the rate pressure product (heart rate X systolic blood pressure) in the uncomplicated MI patient in the coronary care unit on day two after the MI. Twelve subjects were sequentially moved from supine to 70° semi-Fowler to dangle to chair. Heart rate and systolic blood pressure measurements were recorded after three minutes, once position was assumed. There was no difference in the rate pressure product in any of the four patient positions, indicating that myocardial oxygen supply and demand were supported. Thus, position is a safe form of early activity for the uncomplicated MI patient, as measured by the rate pressure product.

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CHAPTER 1

The Study Problem

The patient who has had a recent myocardial infarction (MI) requires rest to insure healing of the damaged myocardium and to prevent complications such as recurrent ischemia, heart failure, cardiac rupture, aneurysm formation, and life-threatening arrhythmias (Swan et al., 1976). Bedrest promotes rest; however, prolonged bedrest may cause other complications such as venous thrombosis, pulmonary emboli, muscle catabolism, and orthostatic intolerance. As early as 1952, Levine and Lown (1952) reported the physiological and psychological benefits of sitting as an alternate treatment for the MI patient. Although sitting prevents the deleterious effects of immobility, it may increase myocardial oxygen demand. Increased myocardial oxygen demand from various positions may increase the risk of complications of the MI patient. It is not known what the effect of common patient positions has on myocardial oxygen consumption (MVO_2) for this population. If the effect of position on MVO_2 using noninvasive measures was established, the nurse could safely and effectively gauge MVO_2 in various patient positions.

Statement of the Problem

Position change following a MI is warranted when the damaged ventricle is hemodynamically able to support cardiovascular changes that occur during and after position change and when the coronary arteries can supply oxygen to meet the increased metabolic demands of the myocardium. The energy utilized by the myocardium during activity should not exceed the oxygen supplied by the coronary arteries. Change in position is one early activity of the patient. After assuming a position, the nurse needs to assess oxygen demands before the patient exceeds his oxygen supply and develops angina. The effect of position on MVO_2 in the uncomplicated MI patient has not been documented using noninvasive means.

Purpose of the Study

The purpose of the study is to determine the effect of selected positions on rate pressure product (RPP) in the uncomplicated MI patient on day 2 after the MI while the patient is hospitalized in the coronary care unit (CCU). Positions to be examined include (a) supine position, (b) 70° semi-Fowler bed position, (c) dangle position, and (d) upright in a bedside chair.

Significance

During hospitalization in the CCU, the nurse is responsible for minimizing the patient's myocardial oxygen demands by promoting bedrest. Even though bedrest assists healing by limiting the patient's activity, low level activity periods such as changing position must be included in the patient's care to combat the deleterious effects of bedrest.

Early activity following a myocardial infarction has become routine care in many CCUs. If positions alter MVO_2, the nurse needs to be able to assess signs of ischemia prior to its development. Presently, there is no literature which reports the effect of various positions on MVO_2 in the uncomplicated MI patient using noninvasive measures. The Rate Pressure Product (RPP), a noninvasive means of measuring MVO_2, is the product of heart rate (HR) and systolic blood pressure (SBP). Documenting the RPP during the supine, 70° semi-Fowler, dangle and chair positions will reflect MVO_2 utilization. These data allow the nurse to monitor and gauge the patient's cardiac response to low level activity using a scientific base.

Assumptions

1. The initial cardiovascular response immediately following the assumption of the supine, 70° semi-Fowler, dangle and chair position will be stabilized after three minutes.

2. The RPP does not reflect volume, contractile, or geometric changes which may influence MVO_2 values.

3. The patient will promptly report exertional or resting chest pain during each position.

Hypothesis

There will be no difference in the RPP of the uncomplicated MI patient in the supine, 70° semi-Fowler, dangle, and chair position.

Definitions

Angina

Any substernal chest discomfort which is described by the patient as typical anginal pain. Angina will be suspected if the chest discomfort radiates to the arms, the throat, the neck, or the jaw. The discomfort may be described as "tight," "pressing," "squeezing," "choking," or "smothering" in nature (Cannon, 1979). Sharp precordial chest pain aggravated by breathing or pain elicited by palpating the chest wall will not be considered angina.

Day Two From Myocardial Infarction

A minimum of 24 hours and maximum of 48 hours since admission to the CCU.

Early Activity

Activity performed in the CCU of low intensity, 1-2 mets, i.e., one to two times the resting metabolic rate (1 met = approximately 3.5 ccO_2/kg body weight per minute). Such activities include hand and face washing, brushing of teeth, use of a bedside commode and sitting in bed or in a bedside chair (Wenger, 1978).

Heart Rate (HR)

The number of times per minute the left ventricle completes the cardiac cycle as calculated by counting the number of R to R cycles in a 15-second electrocardiograph recording and multiplying by four.

Myocardial Oxygen Consumption (MVO_2)

The amount of oxygen consumed by the myocardial tissue as reflected by the rate pressure product.

Positions

Position. After the patient assumed one of the four positions described, steady state is established after maintaining the position for three minutes. By establishing steady state, position did not include cardiovascular effects caused from initial position change. Position, therefore, began at three minutes after position assumption and includes only those cardiovascular responses associated with each position.

Supine. The patient is positioned in bed with the backrest at a 30° angle and with legs horizontal. One pillow will be used to support the patient's head.

70° semi-Fowler. The patient is positioned in bed with the backrest at a 70° angle and with legs horizontal. One pillow is used to support the patient's head.

Dangling. The patient is sitting on the edge of the bed with the feet dependent.

Transfer. After initially standing at the bedside, the patient pivots toward the chair by using a minimum number of steps. The nurse provides assistance only to assure safe transfer.

Chair. The patient is sitting at a 90° angle in a cushioned reclining chair with the feet flat on the floor.

Rate Pressure Product (RPP)

An index of MVO_2 which is calculated from the product of HR and SBP.

Steady State

A state implying a balance of needs between cardiovascular supply and tissue metabolic demand. Steady state is achieved 3 minutes from the completion of the position change (Donald, Bishop, Cumming, & Wade, 1955).

Systolic Blood Pressure (SBP)

Once a blood pressure cuff is placed over a brachial artery and inflated, the SBP is the point at which the initial tapping sound is heard as the blood pressure cuff is deflating (Kirkendall, Feinleib, Fries, & Mark, 1980). SBP is represented by the number digitally displayed by the automatic blood pressure cuff.

Uncomplicated Myocardial Infarction

Myocardial infarction is defined by the following criteria: a rise in the serum level of creatinine kinase (CK) and the presence of myocardial isoenzyme (CK-MB) activity greater than or equal to 3% by day two of the postmyocardial infarction period.

Myocardial infarction is considered "uncomplicated" when the following states are absent: ventricular tachycardia or fibrillation, second or third degree atrioventricular block, pulmonary edema, cardiogenic shock, infarct extension, persistent hypotension (SBP less than or equal to 90 mm Hg), sinus tachycardia (resting HR exceeds 100 beats/minute), or sustained supraventricular tachycardia (Pryor, Hindman, Wagner, Califf, Rhoads & Rosati, 1983).

CHAPTER 2

Literature Review

Physiological Principles of Cardiac Function

The heart is an aerobic organ, which must oxidize substrates to efficiently generate energy for electrical and mechanical functions. After depolarization, actin and myosin myofibrils combine by utilizing adenosine triphosphate (ATP) and cause a muscle contraction. During the recovery and maintenance phase of contraction, ATP is resynthesized in the mitochondria through oxidative phosphorylation. ATP utilized, ATP synthesized, and oxygen consumed for ATP regeneration are all in equilibrium when an aerobic pathway is used to supply energy for myocardial metabolic demands (Braunwald, 1971; Weber & Janicki, 1979).

Myocardial oxygen demands are primarily determined by (a) contractility, i.e., the inotropic state of the myocardium; (b) HR; and (c) myocardial wall tension resulting from left ventricle pressure and volume ratios (Braunwald, 1971; Katz, 1960; Sonnenblick & Skelton, 1971; Weber & Janicki, 1979). Basal metabolism, depolarization, initial activation, maintenance of the activated state, and fiber shortening require a small percentage of the total amount of oxygen consumed. The physiological state of the myocardium, oxygen demand, oxygen supply, and method of loading the heart directly influence which major consumers of myocardial oxygen are utilized to complete contraction and support cardiac output.

As defined by the law of LaPlace, myocardial wall tension is directly proportional to ventricular pressure and ventricular volume (as reflected by the radius) when the ventricle is not hypertrophied. During diastole, myocardial contractile fibers shorten isometrically. The maximum volume at end diastole is known as preload. Frank Starling's law states that ultimate isotonic contraction of the myocardium is dependent on the initial length of the muscle fibers established by preload.

As blood is ejected during systole, the myocardial fibers contract isotonically against resisting factors created by the end diastolic volume of the ventricle, the peripheral vascular resistance, the mass of blood in the aorta, and the viscosity of the blood (Hurst, 1982). The sum of these resisting factors is known as afterload. Monroe (1964) investigated MVO_2 during specific points of developed left ventricular systolic pressure. He reported that by peak systole, the ventricle has consumed 91% of the total amount of myocardial oxygen required. The oxygen cost of developing tension as opposed to relaxation of the left ventricle is a major determinant of MVO_2 (Braunwald, 1971; Monroe, 1964).

Myocardial contractility is related to the force of contraction and the speed of contraction (Braunwald, 1971; Sonnenblick & Skelton, 1971; Weber & Janicki, 1979). Pharmacological agents, catecholamines, hypoxia, acidosis, autonomic nerve impulses, and the length of the fiber can influence contractile state (Braunwald, 1971; Katz, 1960; Sonnenblick & Skelton, 1971; Weber & Janicki, 1979). Heart rate determines the number of times per minute tension must develop to contract the myofibrils.

Ischemic damage to the myocardium can alter the method of loading the heart and depress the inotropic state. MVO_2 demands can rise from supporting cardiac output (CO), the product of HR and stroke volume (SV). Fibers can remain stretched, increasing myocardial tension and causing a noncompliant, dilated chamber. A depressed contractile state can decrease SV causing HR to increase to maintain CO. The rise in HR increases the frequency of tension developed while also decreasing diastolic filling time. If CO is not supported, systemic vacular resistance (SVR) rises, thus increasing arterial blood pressure and afterload.

Since the heart functions solely in an aerobic metabolic pathway, sufficient oxygen supply from the coronary arteries is crucial following a MI. The amount of oxygen available to the myocardium is determined by (a) arterial oxygen concentration, (b) coronary flow and its distribution within the myocardium, (c) coronary microcirculation, and (d) coronary oxygen extraction (Weber, 1979). Coronary flow increases by vasodilation either from autoregulation or from chemical or neurogenic stimuli. Mechanical factors which effect the volume of coronary flow are (a) resistance from myocardial contraction or from the arterial tree, (b) diastolic time, and (c) diastolic blood pressure (Hurst, 1982). Since the heart normally extracts 65% to 75% of oxygen for a wide variety of conditions, maximal oxygen extraction above 75% represents a minor, secondary response to increments in myocardial oxygen demand (Weber & Janicki, 1979).

Position

Low level activity, such as position, is well tolerated when cardiac reserve mechanisms are intact, CO is supported, and myocardial oxygen supply and demand are in balance. Unlike the supine position, the effect of gravity from sitting creates venous pooling in the extremities. Resting SV in the sitting position is lower than in the supine position, however, left ventricular and diastolic volume remains equivalent in both positions (Littell, 1981a). Even though resting HR is greater in the sitting than the supine position, HR increases only to support CO (Gregg, 1963; Littell, 1981a; Littell, 198b). Blood pressure is not usually singificantly altered.

MVO_2 also may vary depending on the effects of HR and ventricular volume changes from position. Elevated heart rates supporting CO increase tension by upgrading the rate of tension development while enhancing the contractile state by allowing faster contractions.

A steady state balancing cardiovascular supply and metabolic tissue demand is achieved within minutes after a position is maintained. Donald, Bishop, Cumming, and Wade (1955) studied the effect of exercise on the cardiac output and circulatory dynamics of 16 healthy subjects. Baseline cardiac output measurements were received in the supine position prior to exercise and also during 1-minute intervals during a 50-minute exercise period. The subjects were grouped according to four grades of exercise performed. Regardless of the grade of exercise performed, heart rate, blood pressure, oxygen uptake, and oxygen saturation reached a steady level by three minutes of exercise.

The Rate Pressure Product

The major determinants of MVO_2 are HR, myocardial wall tension, and contractility. According to the law of LaPlace, myocardial wall tension is directly proportional to preload and afterload. Since aortic systolic pressure reflects afterload, systolic blood pressure can represent tension. With HR being easily measured, the rate pressure product (HR x SBP) is a noninvasive index of MVO_2 when aortic stenosis or conduction disturbances are not present.

Kitamura, Jorgensen, Gobel, Taylor, and Wang (1972) investigated MVO_2 through cardiac catheterization of 10 normal young male subjects during upright bicycle exercise. A .90 correlation between MVO_2 and the RPP was reported. Gobel, Nordstrom, Nelson, Jorgensen, and Wang (1978) evaluated hemodynamic predictors of MVO_2 in 27 men with ischemic heart disease during rest and symptom tolerated maximal exercise. The RPP correlated well with MVO_2 ($r = .83$). Baller, Schenk, Strauer, and Hellige (1980) examined MVO_2 indices of 13 male patients with coronary heart disease at rest and reported a .915 correlation between the RPP and MVO_2. Nelson, Gobel, Jorgensen, Wang, Wang, and Taylor (1974) studied MVO_2 indices during static (isometric) and dynamic (isotonic) exercise in 10 normal subjects and found that MVO_2 correlated with the RPP whether the blood pressure was obtained by a central aortic catheter ($r = .88$) or by a blood pressure cuff ($r = .85$).

Although the RPP does not take into account contractility, volume changes, or ventricular geometric factors, this index correlates well with MVO_2. The slight variations of correlations reported in the research may reflect measurement error or limitations of this noninvasive measurement of MVO_2.

Research on Position and the Rate Pressure Product

After an uncomplicated MI, decreased physical activity from bedrest allows the heart to meet metabolic demands without exceeding oxygen supply. If activity is begun before the heart can normally support cardiovascular function, anaerobic metabolism must be utilized, further increasing the risk of complications.

Despite the benefits of bedrest, prolonged bedrest can cause deleterious effects. Increased blood viscosity leading to thromboembolism, hypostatic penumonia, muscle and bone atrophy, and orthostatic hypotension are common side effects of bedrest (DeBusk, Spivack, van Kessel, Graham, & Harrison, 1971).

Research has demonstrated that complications from bedrest involving the cardiovascular system are due to hydrostatic changes as well as deconditioning. Heebink (1981) reports the work completed by Jere Mitchell in which nine college students were placed on bedrest in a supine 5% headdown position for 24 hours. Blood volume decreased 350 cc after bedrest. Pressure receptors stimulated from greater fluid volumes in the central body caused urine output to increase while the students were in the supine position thus reflecting hydrostatic change from bedrest.

As early as 1952, research reported the benefits of sitting as an alternate treatment for the myocardial infarction patient (Beckwith, Kernodle, LeHew, & Wood, 1954; Hayes, Morris, & Hampton, 1974; Levine & Lown, 1952). The sitting position reduced cardiac volumes, thereby decreasing tension development and also helped maintain vasomotor resopnses. In addition, patients also reported increased morale when able to sit in a chair.

Levine and Lown (1952) treated 81 patients with acute coronary thrombosis by sitting them in a chair within one week of the attack. Thirty of the 81 patients were able to sit in a chair by the second day without acute side effects. Beckwith, Kernodle, LeHew, and Wood (1954) alternately placed 80 patients with acute MI into a chair treatment or bedrest treatment. Patients included in the chair treatment were allowed in a chair on day two after the infarction. The chair group showed no difference in the incidence of cardiac complications when compared with the bedrest group. In another study, 189 patients with uncomplicated MI were randomly assigned into different mobilization groups. In the early mobilization group, patients sat out of bed at 48 hours after hospital admission. Until their discharge at nine days after hospitalization, activity was not restricted. In the late mobilization group, patients were confined to bed for nine days except for commode privileges. On the ninth day from admission, patients began unrestricted activity for one week and were discharged on day 16 of hospitalization. Mobilization after two days as compared to mobilization after nine days did not increase morbidity or mortality rates (Hayes et al., 1974).

Even though scheduled periods of sitting are an acceptable form of treatment in coronary care units for the uncomplicated MI patient (DeBusk et al., 1971; Hayes et al., 1974), there has been little research reported on the cardiovascular effects of positioning. Coe (1954) examined the work of the heart in the armchair position as compared to the recumbent position. Six patients were studied, three had normal cardiovascular systems and three were diagnosed with arteriosclerotic heart disease. In all patients, HR rose minimally upon sitting. The SV for each patient was smaller in the armchair position and the mean reduction of external work in the armchair position represented 23%.

Prakash, Parmley, Dikshit, Forrester, and Swan (1973) evaluated the effects of position in 21 patients with acute MI. After moving from supine to 70° erect position and maintaining the erect position in bed for 5 minutes, there were no signficant changes in SV, HR, or aortic SBP (p values were not listed).

Pulmonary capillary wedge pressure (indicating left ventricular end diastolic volume) was significantly elevated ($p \leq .01$) after maintaining the 70° erect position.

Several nursing studies have sought to analyze common patient positions. McCarthy (1968) focused on the metabolic cost of maintaining five fixed body positions (supine, prone, left lateral, right lateral, and sitting) in five young normal women. In contrast to this study, the sequence of positioning was randomly chosen. Sitting was defined as laying flat in bed with the head of the bed elevated 30° and the foot of the bed level. Supine was flat in bed. An equilibration period of 15 to 20 minutes was allowed between position changes. Through analysis of variance, heart rate was shown to rise significantly ($p < 0.05$) after moving from supine to the sitting position. No blood pressure measurements were recorded. The sitting position is a normal "bedrest" position of hospitalized patients and RPP cannot be calculated since blood pressure measurements were not recorded. Even though this was an early attempt by nursing to record metabolic demand in common positions, no clinical conclusion can be drawn concerning position and RPP.

Jackson and Kinney (1978) investigated energy expenditure, HR, rhythm, and blood pressure in 34 normal female subjects placed in common patient positions and modes of patient transfer. The sequence of the five patient positions were as follows: (1) semi-fowlers, (2) dangling, (3) sitting in a wheelchair,

(4) semi-fowlers repeated, and (5) flat on a stretcher. Baseline was established by having the subjects lie semi-fowlers (no angle was stated for elevation) in bed with one pillow for 11 minutes. Three minutes were allowed for each position change while 3 minutes maintaining each position reflected "steady state." Heart rate and blood pressure for each position were recorded at 2 and 4 minutes within the 6-minute time frame. Heart rate was affected by position but not by time within each position ($p < 0.0001$). Using ANOVA for data analysis, systolic blood pressure did not vary significantly in either maintaining positions or in various modes of transfer. The highest mean heart rates for the 4 minute measurement were in the dangling and wheelchair position, with dangling initiating the greatest change from semi-fowlers. These two positions consumed the largest amount of myocardial oxygen as estimated by the RPP from the data listed by Jackson and Kinney (1978).

It is difficult to estimate an acceptable increase in RPP during low grade activity from a specific baseline state since RPP values that induce angina are only tested during medically supervised conditions. Robinson (1967) studied the effects of isometric exercise of 15 patients with angina pectoris and related HR and SBP to the onset of pain. A patient's precipitation of angina was consistently related to a specific rate pressure product. The percent increase of the RPP from the resting, pain-free state to the angina state varied between 20% and 208%

when calculated from the published data.

In summary, early activity (such as face and hand washing, shaving, brushing teeth, using the bedside commode, and eating) for the uncomplicated MI patient in the CCU has become routine care, provided angina is not precipitated by increased myocardial demands. Research done specifically relating early position change, a form of low level activity, and MVO_2 has not been documented in the literature. Research results reported on the effects of various positions have been conflicting. The response of HR after position in various population groups is not known since the description of positions and length of time spent within each position are not comparable. SBP measurements were not recorded for all the studies cited.

The study proposed was adapted from the Jackson and Kinney (1978) design. Recording RPP (HR and SBP) at three minutes after position change from supine to 70° semi-Fowler to dangle to chair will be used to examine patterns of MVO_2 usage. Jackson and Kinney (1978) did not operationally define the positions assumed and this study will operationally define each position. This study will extend knowledge by examining RPP for percent increases from baseline RPP. These data provide a basis for safe positioning of the uncomplicated MI patient recovering in the CCU during early activity.

Rogers' Theory of Nursing

Along with the physiological model, Rogers' conceptual system for nursing can be used to interpret the relationship between RPP and position. Her three principles of hemodynamics have been formulated using energy field, openness, pattern, and four dimensionality as the four concepts basic to nursing. Rogers (1984) proposes in the Principle of Helicy that changes occur unidirectionally, in sequential order, and will never repeat themselves. She theorizes that changes in both humans and environment occur in constant waves, declining and accelerating with new experiences in the Principle of Resonancy. Finally, in the Principle of Integrity she postulates that interaction between human and environmental fields is continuous, mutual, and simultaneous. Identifying various patterns that characterize changes resulting from the human/environment interaction process and repatterning these changes so that synchrony between man and environment exists is a function of nursing in this model.

The nursing goal according to Rogers' theory is to cultivate and emphasize activity patterns that do not compromise cardiac function. Rogers stated: "When pattern and organization no longer exist, the integrity of the human field is destroyed and death ensues" (Whelton, 1979).

Myocardial oxygen consumption of the post MI patient is constantly affected by the patient's changing physiological and emotional state and his environmental surroundings. If oxygen requirements are depleted, anaerobic metabolism will be utilized thereby disrupting metabolic homeostasis and increasing the risk of further infarction.

By using the RPP index along with subjective information, the CCU nurse can plan activity-rest periods which will balance myocardial oxygen supply and demand requirements. These nursing interventions for the post MI patient support recovery patterns that should lead to beneficial change.

CHAPTER 3

Methodology

Research Design

This study used a quasi-experimental design, specifically a one-group time series (Campbell & Stanley, 1963). Patients were screened for admission to the study if diagnosed with an uncomplicated MI. Each patient served as his own control. The order of positions assumed remained constant for each patient. Since radical position changes could have induced cardiovascular decompensation and therefore jeopardize patient safety, random order of position and random assignment to position was not included. The research proposal was approved by the Committee on Human Research, University of California, San Francisco.

Description of the Research Setting

Data were collected over a six month period in the CCU of a large county medical center in San Francisco. The CCU has eight individual rooms that surround the central nursing station. Each room is enclosed with sliding glass doors and contains an oscilloscope which displays electrocardiographic tracings. Electrocardiographic patterns from the bedside oscilloscope are relayed to monitors located at the central nursing station.

For MI patient, routine CCU orders are instituted upon admission to the unit and include sitting at the bedside after 24 hours if pain free. Admission laboratory includes CK with MB isoenzymes every 12 hours for the first 24 hours, and then once each morning on the second and third days.

Sample

A convenience sample of 12 patients was used to complete the study. The patients were screened for inclusion in the study by the following (see Appendix C):

1. Presently was in day two of the post MI period.

2. Met the criteria for an "uncomplicated MI".

3. May have been receiving lidocaine prophylactically.

4. Was able to communicate needs during the research study by themselves or through an interpreter.

5. Was not in any other experimental study per request of the medical director of the CCU permitting data collection.

6. Did not have a pacemaker.

7. Did not have aortic stenosis since this clinical process may decrease systolic blood pressure.

The data collection was terminated immediately if the patient experienced the following signs or symptoms (see Appendix D):

1. Unexpected fatigue, weakness, dizziness, lightheadedness, fainting or dyspnea.

2. Chest pain or chest discomfort.

3. Significant rhythm or conduction disturbances such as frequent ventricular ectopic beats (greater than 5 ectopic beats/minute), coupling, paroxysmal atrial or supraventricular tachycardia, and second or third degree A-V block.

4. Increase in HR by more than 20 beats/minute over the

resting state or a decrease by more than 10 beats/minute.

5. A decrease of SBP greater than 20 mm Hg from the resting state.

6. An increase of SBP greater than 20 mm Hg from the resting state for two consecutive readings (adapted from Haskell, 1974).

Instruments

Automatic Blood Pressure Cuff (IVAC Vital Check--Model 1160 EE)

A sphygmomanometer that acoustically analyzes blood flow sounds and electronically records HR and blood pressure simultaneously by displaying the measurements with a flashing red light. Placement of the blood pressure cuff was done according to the American Heart Association recommendations (Kirkendall, Feinleib, Freis, & Mark, 1980) and the IVAC Vital Check Manual.

Karlefors, Nilsen, and Wrestling (1966) compared indirect and direct measurements of arterial pressure during exercise in 38 subjects with various diagnoses. There was a 0.98 correlation between ausculatory and directly measured systolic pressures during rest and exercise. When Nelson, Gobel, Jorgensen, Wang, Wang, and Taylor (1974) studied MVO_2 indices during exercise in 10 normal subjects, MVO_2 correlated with the RPP whether blood pressure was obtained internally by a catheter ($r = .88$) or manually by a blood pressure cuff ($r = .85$). These studies establish validity of manual measurement of SBP during activity. To assure instrument validity, the display test was done prior to beginning data collection for each patient to assure blood pressure function information display messages were operating properly.

Stop Watch

Pocket size hand watch with an external knob for stopping the motion of the second hand was used. Instrument reliability was established by timing one minute on the stop watch and another clock.

Electrocardiograph Monitor (Hewlett-Packard Monitor 78342A)

Bedside monitor which allows continuous visualization of the patient's electrocardiographic (EKG) rhythm.

Auxiliary Recorder (Hewlett-Packard Model 7845A)

A portable recorder which connects to all CCU bedside monitors by a specific attachment site. The recorder duplicates a patient's EKG tracing, independent of the monitors located at the nurses' station. To maintain instrument validity, the auxiliary recorder is routinely checked every fourth month by the hospital's biomedical department.

Protractor

A semi-circle wheel with one degree markings indicating angle measurement.

Procedure

Baseline

Informed consent was obtained from all subjects who met the inclusion criteria. A written information sheet was provided to all subjects who agreed to participate (see Appendix A). The information sheet described the study, identified the risks and benefits for participating, and emphasized that subjects were free to withdraw from the study without any effect on their medical or nursing care.

Data collection was initiated between the hours of 1000 and 1400 for each participant since the hospital setting of this study routinely sat the uncomplicated MI patients in a bedside chair during these times. Patient information sheet (see Appendix B), admission criteria sheet (see Appendix C), and a data collection sheet (see appendix D) were initiated for each participant. Data collection was begun at least one hour after the last meal in order to control for oxygen demand from food digestion and metabolism. The patient remained supine for three minutes after EKG preparation and attachment of the blood pressure cuff to assure steady state.

Preparation of the Patient

Preparation for EKG monitoring included (a) using the same brand of electrodes on all chest placement sites for each patient; (b) a skin prep including soap, water, and shaved chest hair if electrodes were not fastened securely. The patient had electrodes positioned in the modified V_1 position (MCL_1) and modified V_6 position (MCL_6) so rhythm changes or conduction disturbances were easily viewed from the bedside oscilloscope. The MCL_1 hookup consisted of the positive electrode at the fourth right intercostal space and the negative electrode at the left shoulder.

The MCL_6 hookup had the negative electrode at the left shoulder and the positive electrode at the fifth intercostal space at the mid-axillary region (Marriott, 1972). If arrhythmias were not detected from MCL_1, EKG cables were switched to the MCL_6 position.

An automatic blood pressure cuff was used to digitally display SBP. The microphone labeled "artery" was placed directly over the brachial artery and secured by wrapping the cuff. The manual mode was utilized with the cuff programmed to inflate to a maximum of 150 mm Hg or 200 mm Hg, depending on the average of the patient's last three previous blood pressure measurements. The cuff was programmed to inflate to 200 mm Hg for any SBP equal to or greater than 120 mm Hg.

Data Collection

The patient was sequentially positioned from supine, 70° semi-Fowler, dangle, to chair. Three minutes was allowed to change from one position to another. Position change was completed when the patient maintained the specific position with little or no assistance. Each position was maintained for 3 minutes prior to cardiac measurements. One minute was allowed to record SBP, and a 15 second EKG tracing.

The data collection procedure was as follows (see Appendix D):

1. Attach equipment (5 minutes).

2. Bedrest (supine position) for 3 minutes during which time no visitors nor any change of position were allowed.

3. Collect baseline SBP and EKG (1 minute).

4. Change from supine position to 70° semi-Fowlers position (3 minutes).

5. Establish equilibrium (3 minutes).

6. Collect 70° semi-Fowlers position data (1 minute).

7. Change from 70° semi-Fowlers position to dangle position (3 minutes).

8. Establish equilibrium (3 minutes).

9. Collect dangle position data (1 minute).

10. Change from dangle position to chair position (3 minutes).

11. Establish equilibrium (3 minutes).

12. Collect upright chair data (1 minute).

13. Study completed.

Estimated time to complete the entire study was 30 minutes. The staff registered nurse was immediately informed of patient responses during the data collection period that lead to termination of the study.

Data Analysis

Pretest data from the patient information sheet (see Appendix B) was analyzed to describe the characteristics of the sample. A repeated measure, analysis of variance (ANOVA) was used to analyze the relationship between position (independent variable) and RPP (dependent variable).

CHAPTER 4

Results

A sample of 12 patients was studied, nine males and three females. The mean age was 59.3 years, range between 34 and 83 years. Eight patients were receiving supplemental oxygen, however, all patients denied symptoms of dyspnea and none showed evidence of congestive heart failure. At the time of the study, nine patients were receiving nitroglycerin ointment, three patients were receiving a calcium blocker, two patients were receiving an anti-hypertensive and three patients were receiving a beta blocker. Table 1 lists the medical therapies utilized for each patient.

Means and standard deviations for HR, SBP, and RPP are listed in Table 2. RPP ranged from 9887.833 to 10721.833. The mean RPP was the lowest in the supine position (mean RPPsup = 9887.833) and was the highest in the dangle position (mean RPP dangle = 10721.833). The percent increase in RPP from supine to 70° semi-Fowler was 5.14%, 8.43% from supine to dangle and 5.16% from supine to chair. The percent decrease in RPP moving from dangle to chair was 3.01%. See Table 3 for other percent changes associated with position and RPP. There were no complications with any subjects during or after completion of position.

The study hypothesis was supported. There was no difference in the RPP of the uncomplicated MI patient in the supine, 70° semi-Fowler, dangle, and chair positions ($F = 2.309$, $p = 0.0935$, see Table 4).

Table 1

Medication Therapy Used for 12 Subjects During Study

	Oxygen	Nitroglycerin Ointment	Calcium Blocker	Anti-Hypertensive	Beta Blocker
1	X				
2	X	X			
3	X	X			
4		X			X
5					
6	X	X			
7	X	X			X
8	X	X	X	X	
9	X	X	X		
10		X	X		X
11		X		X	
12	X				
Total:	8/12	9/12	3/12	2/12	3/12

No cardiovascular agent: 3/12

Single cardiovascular agent: 3/12

Two cardiovascular agents: 4/12

Three cardiovascular agents: 2/12

Table 2

Descriptive Statistics Based on 12 Observations

Variable	n	Mean	Standard Deviation	Minimum	Maximum
SBPSUP	12	114.667	21.931	88.000	164.000
SBP70	12	118.667	21.865	96.000	164.000
SBPDANG	12	120.750	24.245	92.000	174.000
SBPCHAIR	12	118.000	28.816	81.000	180.000
HRSUP	12	85.000	17.247	56.000	107.000
HR70	12	86.750	17.003	60.000	107.000
HRDANG	12	87.167	18.862	52.000	115.000
HRCHAIR	12	87.000	18.884	54.000	115.000
RPPSUP	12	9887.833	3278.731	5310.000	15416.000
RPP70	12	10396.333	3214.746	6370.000	15416.000
RPPDANG	12	10721.833	3832.445	6045.000	17400.000
RPPCHAIR	12	10398.250	3907.627	5544.000	18000.000

SBP = systolic blood pressure

HR = heart rate

RPP = rate pressure product

SUP = supine

70 = 70° semi-Fowler

DANG = dangling

CHAIR = chair

Table 3

RPP Percent Change Between Various Position Sequences

Position Sequence: supine	70% semi-Fowler	dangle	chair	RPP % Changes
RPP supine---RPP 70° semi-Fowler				5.14% increase
RPP supine------------------------RPP dangle				8.43% increase
RPP supine---------------------------------------RPP chair				5.16% increase
	RPP 70° semi-Fowler--RPP dangle			3.13% increase
	RPP 70° semi-Fowler-----------------RPP chair			.02% increase
		RPP dangle-----RPP chair		3.01% decrease

Table 4

ANOVA for RPP and Position

Source	df	SS(H)	MSS	F	P
Between subjects	11	541093380.0000			
Within subjects	36	24642816.0000			
S	3	4275946.5000	1425315.5000	2.309	0.0935
S X SwGps	33	20367028.0000	617182.6900		

CHAPTER 5

Discussion

Because the RPP is not significantly altered after assuming the supine, 70° semi-Fowler, dangle and chair position, this type of early, low level activity can be considered an appropriate nursing intervention for the uncomplicated MI patient on day two after admission to the CCU. The data indicate that the damaged ventricle is able to support cardiovascular changes that occur from position change and that myocardial oxygen demand from position change is minimal. Since patients did not experience signs or symptoms of cardiovascular decompensation with any specific position, sitting in the chair is the preferred position since it will prevent the deleterious effects associated with bedrest.

The data for the RPP in this study support the "armchair" treatment for the MI patient as described by other research studies (Levine & Lown, 1952; Beckwith et al., 1954; Hayes et al., 1974). Even though these earlier studies evaluated tolerance for early activity or discharge by investigating changes in mortality, early mobilization, which included sitting, was reported as a safe measure.

Percent change patterns of RPP from specific positions and insignificant HR change with position are supported by Coe (1954) and Prakash et al. (1973). Coe (1954) reported that external work of the myocardium was decreaed 23% when patients sat in a chair.

Even though external work is a minor determinant when evaluating total myocardial oxygen consumption, the 3.01% decrease in the RPP in this study when moving from the dangle position to the chair position supports Coe's research. Enhancement of the venous tone from gravity during the transition to an erect posture, causing decreased preload, most likely contributed to these results as well as Coe's results.

Prakash et al. (1973) reported that of HR, aortic SBP, SV, CO, right atrial pressure and pulmonary wedge pressure (i.e., left ventricular end diastolic volume) in 21 acute MI subjects, right atrial pressure and pulmonary wedge pressure were significantly increased ($p \leq .01$) after assuming a 70° erect position (with legs horizontal) from a supine position for 5 minutes, 48 hours after admission to the CCU. In this study, RPP increased 5.14% after assuming the 70° semi-Fowler position from the supine position. The RPP probably rose in response to increased tension development of the left ventricle from an increased preload caused by increased peripheral venous tone. These results on HR and pattern of RPP for the 70° semi-Fowler position support the Prakash et al. (1973) study since population group, position definitions, time within position, and statistical outcomes are comparable. This is clinically important since increments of HR require a much larger expenditure of energy as a result of the force-treppe phenomenon (Weber & Janicki, 1979).

In contrast, McCarthy (1968) reports that HR increased significantly ($p < 0.05$) when five healthy females moved from the supine position to the sitting position. In her study, McCarthy randomized the order and sequence of positioning and considered the sitting position as the head of the bed elevated 30 degrees with the foot of the bed level. Both study design and position definition vary with the present study.

Jackson and Kinney (1978) report that HR was statistically effected by position ($p < 0.0001$) and not by time within position for 34 normal females. They began their positional study from the semi-Fowler position rather than from the supine position. HR and SBP were recorded at 2 minutes and 4 minutes after position change. Mean HR recorded at the 4 minute interval increased 8.35 beats after dangling and decreased 4.29 beats in the wheelchair. These changes in HR do not appear clinically significant since HR elevation greater than 20 beats/minute over the resting state, or HR decrease of greater than 10 beats/minute from the resting state during physical activity are common criteria used when managing MI patients during rehabilitation (Haskell, 1974).

Extrapolated RPP (calculated at the 4 minute interval) from the semi-Fowler position to the dangle and wheelchair positions from Jackson and Kinney's research increased 14.06% and 4.08% respectively and decreased 8.75% from the dangle to the wheelchair position. This pattern of RPP percent changes identifies the RPP percent changes of this study (see Table 3). Regardless of this similarity to the present study, Jackson and Kinney's data appear elevated explained by the fact that healthy subjects were studied. Extrapolated percent change of the RPP from the resting, pain-free state to the angina state (induced by exercise) in patients with known angina was found to range from 20% to 208% (Robinson, 1967). Rate pressure product percent changes from the supine position in this study were all below 8.43% (see Table 3)

As previously stated, the RPP does not accurately reflect oxygen consumption changes caused by volume or contractility changes in the ventricle. Reported RPP for positions may not be totally reflective of the individual effects from position since vasodilators and beta blockers were included in the medical regime. Despite this limitation, all patients completed the study without complciations, thus indicating this form of low level activity is an acceptable nursing intervention for the uncomplicated MI patient.

The reported data have identified several patterns of myocardial oxygen consumption for the MI patient with position. Identification of adaptive patterns reflecting optimum health status is a primary goal in Rogers' nursing theory. Several conclusions from this study can be cited utilizing the concepts derived from Rogers' theory. Since patients did not exhibit arrythmias or signs of cardiovascular decompansation, physical integrity was maintained during alteration of the environment with position. The ability to participate in early, low level activity signifies the initiation of stability during an acute illness.

Formulating future patterns to maintain integrity by monitoring diet and fluid intake, promoting adaptive lifestyle and coping measures, and preventing cigarette and alcohol use will increase future functional status during the rehabilitation period. These patterns allow continuous synchrony between man and his environment.

Using a non-invasive index of MVO_2 (RPP), controlling time in various common patient positions, defining each position, and using the uncomplicated MI patients as subjects are factors unique to this study. By choosing to control these factors, this research study identified RPP changes in relation to early position change. Since myocardial oxygen supply and demand requirements were in balance with position, nurses can plan periods of low level activity for the uncomplicated MI patient, thus supporting recovery patterns that lead to beneficial change. Observing RPP changes in relation to psychological stress, high levels of activity (isotonic vs. isometric), isolated cardiac medical intervention and other cardiopulmonary diseases are topics for future nursing research.

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Appendix A

Written Information Sheet

Date: ____________________

The Effects of Selected Positions on Rate Pressure Products of the Post Myocardial Infarction Patient

Dear Participant:

Thank you for agreeing to participate in my research study. I am interested in the changes of oxygen in the heart during position. It will involve progressing through four common positions: flat in bed, 70 degrees upright in bed, dangling, and sitting in a chair.

During these positions, heart rate and blood pressure will be taken by routine noninvasive measures. A total of four measurements will be amde. Approximately thirty minutes will be required to complete the study. The position changes will coincide with the routine Coronary Care Unit activity and will take place between the hours of 10:00 a.m. and 2:00 p.m.

You are free to withdraw from the study any time. Failure to participate in the study after initial consent was given will not alter present or future nursing care. Questions before the study begins are welcomed. Questions following the study can be answered imemdiately by me or through Nancy Stotts, R.N., Ed.D. at 476-4412.

Thank you,

Susan E. Quaglietti, R.N.
Graduate Student
Department of Physiological Nursing
University of California, San Francisco

Appendix B

Patient Information Sheet

Date:______________Time:_____________

Addressograph

LAB	Test	Normal Values	Reported Value	Date	Time
	Hct/Hgb				
	Na				
	K^+				

CXR Report: Report:

Date [ ] Date [ ]

Time [ ] Time [ ]

MEDS Lidocaine No Yes 1 mg, 2 mg, 3 mg

Other (Diuretics, B-Blocker, Vasodilator, Anti-hypertensive, Inotropic)

1.	4.	7.
2.	5.	8.
3.	6.	9.

MEDICAL HISTORY (Include co-existing illness during hospitalization)

DIET Last meal eaten (must be 1 hour) Time [ ]

REPORT Received [ ] Comments:

MOVEMENT Self [ ] Assist [ ]

Appendix C

Admission Criteria Sheet

Date:________________ Time:____________ Addressograph

LAB	Enzyme	Normal Value	Time of test from admission			
			00	12	24	48
	CK					
	CK-MB (less than 3%)					

DAY TWO (between 24° to 48° from admission)

Time of admission to CCU [ ]

Time of initiation of study [ ]

Total hours [ ]

DIAGNOSIS

Type of MI:________________________________

Complications (check box if present):

1. Pacemaker [ ]
2. Aortic stenosis [ ]
3. V tach/fib [ ]
4. 2nd/3rd AVB [ ]
5. Pul. edema [ ]
6. Cardiogenic shock [ ]
7. Infarct extension [ ]
8. Hypotension (<90 mm Hg) [ ]
9. Sinus tach (Rest HR 100) [ ]
10. SVT [ ]

OTHER

English speaking: Yes No Native language:

Interpreter needed: Yes No ____________________

Info sheet given: Yes No

Verbal consent given: Yes No

Presently in other experimental study: Yes No

Appendix D

<u>Data Collection Sheet</u>

min	Activity	R	RPP	SBP	HR	Complications/Notes
1						
2	Attach					
3	equipment					
4						
5						
6	Rest -					
7	steady state					
8						
9	Supine	///////	///////	////////	///////	
10	Change to					
11	70° position					
12						
13						
14	Steady state					
15						
16	70° erect	///////	///////	////////	////////	
17	Change to					
18	dangle					
19						
20						
21	Steady state					
22						
23	Dangle	///////	///////	////////	////////	
24						
25	Change to					
26	chair					
27						
28	Steady state					
29						
30	Chair	///////	///////	////////	////////	
31	Complete					

PLACE EKG STRIPS

Complication checklist.

1. Fatigue
2. Weakness
3. Dyspnea
4. Chest Pain
5. PVC (greater 5/min.)
6. Coupling PVC
7. PAT
8. SVT
9. 2nd AV Block
10. 3rd AV Block
11. Increased HR - 20 beats
12. Decreased HR - 10 beats
13. Decreased BP - 15-20 mm Hg
14. Dizziness
15. Fainting
16. Lightheaded
17. Increased BP - 30-20 mm Hg

Last three SBP

1.

2.

3.

Average [ ]

Dial set on BP machine [ ]