**Jarkowski, Nancy Lee**

THE EFFECTS OF THERMAL BIOFEEDBACK THERAPY ON PATIENTS IN A CARDIAC REHABILITATION PROGRAM

*The University of Arizona* M.S. 1987

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# THE EFFECTS OF THERMAL BIOFEEDBACK THERAPY ON PATIENTS IN A CARDIAC REHABILITATION PROGRAM

by

Nancy Lee Jarkowski

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A Thesis Submitted to the Faculty of the

COLLEGE OF NURSING

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

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This thesis has been approved on the date shown below:

Carolyn Murdaugh — 3/2/87

CAROLYN MURDAGH
Assistant Professor of Nursing

Date

## DEDICATION

This thesis is dedicated to my mother, Theresa M. Glinski-Finley, and the rest of my family who have been a great help and great source of encouragement throughout my school years.

ACKNOWLEDGMENT

Sincere appreciation is extended to Dr. Carolyn Murdagh who chaired my committee, for not only her editorial support but for the encouragement and guidance needed to complete this thesis.

Thank you to Dr. Patricia Fairchild for her expertise in biofeedback and to Dr. Joyce Verran for her help when needed. Also, I would like to thank the Arizona Affiliate of the American Heart Association for their generous grant.

Thank you to the staff and patients at the various cardiac rehabilitation centers especially to Nancy Hamilton, Marilyn Woods and Carol Martin for their help with this study.

Thank you to Jamie Benedict and Gerri Lamb for their help in the research laboratory.

A special thanks to Joanne Glinski, my sister, for her help typing this manuscript, to Chuck Waldron for the use of his computer, and to my other family members, friends and co-workers for their encouragement and support. Greatest of all I thank the Lord who made all things work together! Amen.

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# ABSTRACT

An experimental study was conducted to compare the effects of implementing thermal biofeedback therapy within a cardiac rehabilitation program. The sample consisted of twenty subjects diagnosed with coronary artery disease who were non-diabetic, non-smokers, not taking beta adrenergic blocking agents, without psyciatric disease and without training in thermal biofeedback.

Variables included blood pressure and anxiety. The angina variable was omitted due to lack of subjects experiencing angina. Comparisons between the control and experimental groups and pre and post tests within the experimental group were made utilizing a t-test.

No significant differences were found in the anxiety measures. A significant difference was found between the control and experimental groups post test systolic blood pressure and between pre and post test systolic and diastolic blood pressure within the experimental group. The results of this study indicate that nurses should consider thermal biofeedback therapy in conjuction with the exercise program at cardiac rehabilitation centersas a method of blood pressure reduction.

# CHAPTER 1

## INTRODUCTION

In the following chapter, the purpose and significance of a study utilizing biofeedback assisted relaxation therapy in a cardiac rehabilitation program will be described. The need for nurses as health care professionals to determine what benefit such therapy may have on patients is expressed.

### Overview of the Problem

Coronary heart disease (CHD) is the leading cause of death in the United States, and may be considered an epidemic of modern civilization. The disease can cause significant physical and emotional disabilities. Several risk factors for CHD have been identified and are found in 40 to 60 percent of patients with myocardial infarctions. These include: a family history of the disease, hypertension, hyperlipidemia, obesity, cigarette smoking, physical inactivity, diabetes, and Type "A" or coronary prone personality. Prevention and reduction of the morbidity and mortality of CHD depends on the reduction of these risk factors (Ott, et al., 1983; Kannel and Dauber, 1982; Brady, 1977).

Cardiac rehabilitation programs have developed throughout the country to treat people with or at risk for CHD. Goals for the programs are to improve quality of life by helping the patient reach and maintain an optimal physical, psychological, social and vocational state. These goals are achieved through exercise training, educational opportunities and counseling. Exercise in itself may improve endurance and self confidence, lower blood pressure and cholesterol, increase tolerance to stress and improve overall myocardial efficiency (Fletcher, 1984; Razin, 1982; Naughton, 1977). Thus, the major emphasis of cardiac rehabilitation is on structured exercise. Indeed, some studies have shown the effects of running alone to match those of psychotherapy (Ott, et al., 1983; Rahe, Ward and Hayes, 1979; Hellerstein, 1979).

The psychological morbidity of CHD is considerably high and can be devastating. The inability to return to a normal life style, stress, fatigue, anxiety and depression plus physical symptoms follow patients home and often exhaust their resources to cope. Patients in whom these problems persist have higher mortality rates, are less likely to return to work, are frequently readmitted to the hospital and less likely to resume sexual activity. Depression and anxiety often persist for several years after hospitalization despite physical exercise and psychotherapy (Kolman, 1983; Pathy and Peach, 1980; Langosch, et al., 1982; Razin, 1982).

Heart clubs, counseling, group therapy, exercise training, relaxation techniques and biofeedback have all been used successfully in reducing anxiety in cardiac patients (Everly and Rosenfeld, 1981; Wentworth and Rohr, 1984; Ott et al., 1983; Hacket and Cassem, 1978). Utilization of modern technology to provide patients with instantaneous feedback about body processes opens up a new means by which the patient may take control over body functions not normally thought to be consciously controllable (Brown, 1977). Thermal biofeedback offers promise in helping patients control their reaction to anxiety producing situations, physical reactions that may be detrimental to their health (Wentworth and Rohr, 1984; Green and Green, 1979). These topics will be covered in greater detail in the following chapter.

Health care professionals interested in the total well being of patients have the responsibility to help them cope with the anxiety commonly associated with cardiac disease. Such efforts may reduce or prevent further complications from CHD and improve the patient's quality of life from a psychological as well as a physical standpoint. This research investigated the effects of implementing a structured, economical and easy to understand method of assisting patients in a cardiac rehabilitation program cope with the anxiety commonly associated with CHD.

## Purpose of the Study

The purpose of this research was to study the effect of biofeedback assisted relaxation therapy on patients in a cardiac rehabilitation program on 1) blood pressure, 2) anxiety level, and 3) frequency of angina attacks.

## Significance of the Study

Coronary heart disease is a major health problem in the United States. Risk factor reduction has been shown to improve the morbidity and mortality of the disease. Cardiac rehabilitation programs are designed to facilitate risk factor reduction. However, their primary emphasis is toward physical reconditioning leaving many patients on their own to cope with the psychological stresses of coronary heart disease. Health care professionals who have the primary responsibility of educating and counseling patients must investigate new methods to teach patients to cope successfully with their disease. Teaching patients a method of coping with the psychological impact from CHD thus decreasing anxiety and its psychophysological effects may reduce some risk factors, improve quality of life and reduce the risk of further physical or psychological disability. This researcher believes that inclusion of thermal biofeedback assisted relaxation therapy offers a more holistic approach to cardiac rehabilitation integrating mind and body exercises (Everly and Rosenfeld, 1981).

## Summary

This chapter has discussed the mortality and morbidity of CHD and has briefly described the focus of most cardiac rehabilitation programs. There is a need for psychological as well as physical conditioning for patients with CHD. This researcher proposed a study to implement a form of psychological conditioning, thermal biofeedback assisted relaxation therapy, within the framework of a cardiac rehabilitation program.

# CHAPTER 2

## THEORETICAL FRAMEWORK

The theoretical framework describing the postulated effects of implementing thermal biofeedback therapy in a cardiac rehabilitation program will be presented in this chapter. A theoretical framework (see Figure 1) has been provided to illustrate the relationships at the construct, concept and operational levels. First to be discussed is the relationship between relaxation and the stress response. Secondly, thermal biofeedback and its relationship to anxiety, blood pressure and angina will be reviewed. Results of studies investigating the relationship between these variables are presented.

### Relaxation

Relaxation is a general psychophysiological wakeful state where mind and body are at rest. There is an absence or marked decrease of anxiety, tension and discomfort (Wentworth and Rhor, 1984). The relaxation response is the opposite of the stress response. Relaxation causes a decrease in sympathetic nervous system activity. It is an innate response within every person just as are excitement and anger, is mediated by the hypothalmus and may be used to offset inappropriate activation of the stress response (Benson, 1975 and 1977). Decreased adrenal outflow, heart rate, blood pressure, muscle tension, respiration and sensory input to the brain are results of the relaxation response (Wentworth and Rhor, 1984). Electroencephalograms demonstrate slow

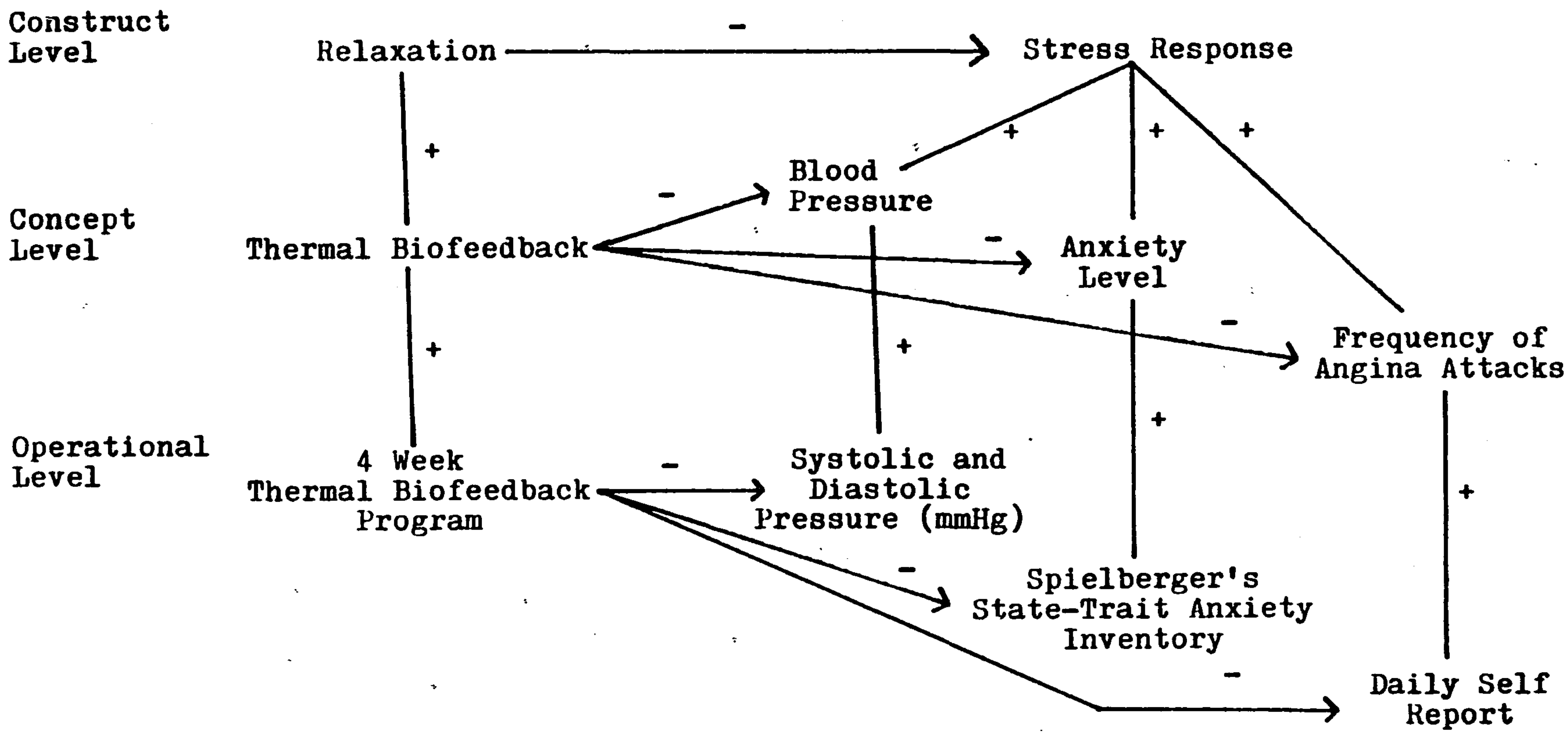


Figure 1. Theoretical Framework: The Effect of Thermal Biofeedback on the Stress Response.

alpha waves and occasional theta waves. The physiological changes found during the relaxation response are different than those produced by sleep or by quietly sitting with one's eyes closed (Benson, 1977).

Techniques for eliciting the relaxation response have existed for centuries and include yoga, meditation, prayer, hypnosis, hot baths, drugs and massage. Benson (1977) describes four basic points that several of these techniques have in common. They are: 1) a quiet environment, 2) muscle relaxation, 3) a passive attitude, and 4) a mental device such as a sound, word or words repeated audibly or silently. Visual imagry or mental pictures of warm and relaxing things have also been used. Side effects include feelings of warmth in hands, floating sensations, mild sexual arousal, and lacrimation. Prolonged elicitation of the relaxation response has reportedly caused insomnia, visual phenomena and psychotic manifestations including hallucinations. Some patients taking propranalol required lower doses of the drug because of marked bradycardia and several diabetics required reduction of their insulin due to hypoglycemic reactions (Hoffman et al., 1982; Benson, 1977).

## Progressive Relaxation

Jacobson's relaxation research began in the early 1900's at Harvard University where he studied the muscular correlates of anxiety and tension. His work published in 1929 demonstrated that individuals could learn to relax by alternately contracting and relaxing major muscle groups. This was termed progressive relaxation -- progressing through the body with the exercise. The theory behind progressive muscle relaxation is that it counteracts tension and since bodily tension and anxiety are closely related, relaxation of muscles will lead to a reduction of anxiety and its physiological manifestations. By experiencing tension and learning its sensation, one can recognize tension sooner and learn to control it with relaxation techniques (Fischer-Williams et al., 1981; Wolpe, 1973).

Autogenic Training

Autogenic training is a form of self-hypnosis capable of producing a relaxed state of mind similar to that obtained by practicing Benson's or Jacobson's techniques (Shealy, 1977). Use of self-hypnosis to bring about relaxation and possibly cure anxiety-produced disease has existed for centuries. Emil Coue, a Frenchman born in 1857 has been acredited with the widespread application of the healing powers of the mind. His work published in 1922 promoted the theory that a person, if physically able, could persuade himself through the use of his imagination to do anything. He believed that "we are what we think we are and the fear of failure becomes in itself the cause of failure" (Shealy, 1977, p. 35). Coue's patients were instructed to practice general muscle relaxation in bed before going to sleep. As they progressed into a semi-conscious state similar to daydreaming, they were to introduce into their mind any desired thought. The unconscious mind would then turn that thought into a reality by programming the mind to think in such a way. According to Coue, the process of curing a chronic disease could take up to six months (Shealy, 1977).

Autogenic training was developed by a German physician, Johann Schultz. Wolfgang Luthe, his student, later expanded the program into what is used today (Fisher-Williams et al., 1981; Shealy, 1977). The phrases forming the basis of this program address warmth and heaviness throughout the body. They are incorporated into the autogenic relaxation script found in Appendix F-5. The repetition of statements like these often leads to a state of deep relaxation with peripheral vasodilatation (Green and Green, 1979). In the relaxed state patients develop increased awareness of internal stimuli and decreased reaction to external stimuli. With the improved awareness of the bodies internal state and the use of biofeedback, it is possible for a patient to consciously alter bodily functions not normally thought to be controlled by the conscious mind (Shealy, 1977; Green and Green, 1979). Many studies have used autogenics successfully in conjunction with biofeedback training (Fisher-Williams et al., 1981). Both Jacobson's progressive relaxation and autogenic training will be incorporated into this studies thermal biofeedback training program (Appendix D).

## Stress Response

In general, the stress response is the body's reaction to noxious stimuli. Stress has been defined as a non-specific response of the body to any demand placed upon it (Selye, 1976). Cannon in 1929 described stress as the fight-flight response to an emergency state resulting in the activation of the sympathetic nervous system (Shaffer, 1982). A stressor is an event or thing that causes stress. Examples of stressors are: a threat of harm, personal conflict, physical injury, temperature changes, or life changing events such as marriage, the birth of a baby, or a death in the family. Stressors are very individualized; what may be stressful to one person may not be to another. When a stimulus, either physiological or psychological, is perceived as unpleasant and fearful, anxiety occurs activating the stress response (Wentworth and Rhor, 1984; Shaffer, 1982).

The stress response originates in the cerebral cortex as a complex psychophysiological reaction effecting the nervous and endocrine systems. Initial reaction is from the automatic nervous system's release of catecholamines at nerve endings producing effects presented in Figure 2. These direct neuro end organ responses are immediate but short acting. The neuroendocrine response utilizing the circulatory system for transport gives an intermediate response requiring a higher intensity stimulus to activate, and the pure endocrine response is longest acting (Everly and Rosenfeld, 1981; Guzzett and Forsyth, 1979).

The cardiovascular system is thought by many researchers to be the prime target for the stress response. This is because the "physiological components of increased sympatho-adrenomedullary (SAM) activity are 1) increased blood pressure and heart rate; 2) increased myocardial oxygen utilization; 3) increased circulatory levels of epinephrine and norepinehprine; 4) increased plasma concentrations of free fatty acids; and 5) increased plasma renin activity -- all of which predispose one to cardiovascular disease." (Weise, Herd and Fox, 1981, p. 55.) Chronic activation of the SAM response may lead to irreversible damage to the cardiovascular or other body systems (Everly and Rosenfeld, 1981; Selye, 1976).

Selye (1976) labeled the specific sequence of events produced by stressors the "General Adaptation Syndrome" (GAS). Three stages have been identified: alarm reaction, state of resistance and stage of exhaustion. The alarm reaction produces the SAM response which prepares

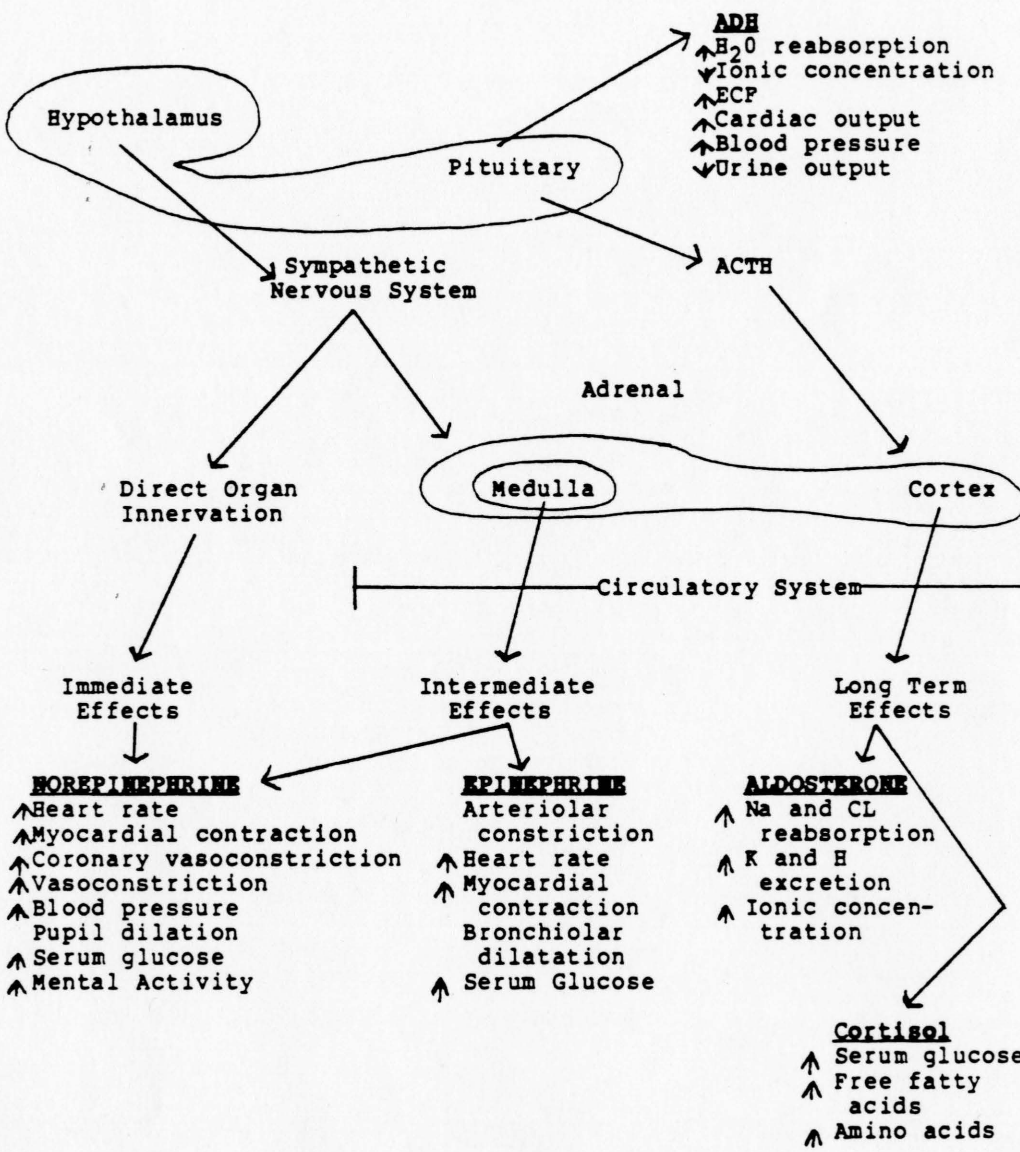


Figure 2. Physiologic Stress Response
Adapted from Everly and Rosenfeld, 1984, p.30
and Guzzetta and Forsyth, 1979, p. 33.

the body for fight or flight. In the stage of resistance the body is mobilized to combat the stressor as the alarm stage tapers off and the body attempts to return to normal. Yet if the body remains mobilized with repeated alarm responses, its resources will become depleted so that exhaustion sets in. At this point the body may continue to repeat the alarm reaction but it becomes increasingly more vulnerable to organic dysfunction and disease.

The mind and how it perceives and copes with stress plays a major active role in triggering the GAS. If one can be taught either to perceive an event as "safe" or not harmful or how to cope with stress and anxiety, the devastating effects of GAS and chronic arousal of SAM response may be halted (Shaffer, 1982; Everly and Rosenfeld, 1981).

"It is not stress that kills us but our reaction to stress" (Basmajian, 1979, p. 159).

## Thermal Biofeedback

Basically, biofeedback accelerates the learning process by providing a speedy method of relaying information back to a person about his own physiological processes. With feedback a person can learn to control body processes usually thought to be involuntary or uncontrollable, demonstrating conscious mind control over the body (Ryan, 1975; Lamott, 1974; Brown, 1977). Many types of biofeedback have been utilized successfully with cardiac patients. These include feedback on heart rate, heart rhythm, muscle tension, blood pressure, galvanic skin resistance and others (Williamson and Blanchard, 1979; McGrady et al., 1981). Relaxation techniques are a standard conjunctant with biofeedback therapy (Wentworth and Rohe, 1984) and may work synergistically (Budzynski, 1978).

When temperature is utilized as the physiological process for biofeedback it is termed thermal biofeedback. Peripheral temperature biofeedback is one type of thermal biofeedback during which the patient is given immediate feedback of the temperature on an extremity, usually a finger. Peripheral temperature biofeedback is cost effective, convenient, generally understood, and is an indicator of sympathetic arousal (Green and Green, 1979; Everly and Rosenfeld, 1981).

> "By measuring the temperature in the extremities, one can get an indication of the amount of the constriction of the blood vessels, and since the constriction-dilatation is controlled by the sympathetic portion of the autonomic nervous system, one can get a second indirect measurement of the amount of sympathetic activity." (Everly and Rosenfeld, 1981, p. 148)

Peripheral temperature biofeedback has been effective in the treatment of peripheral vascular diseases such as Raynaud's, migrane headaches, hypertension and when control of sympathetic activity is desired, as in this study. Even rheumatoid arthritis sufferers have benefited from the hand warming therapy (Everly and Rosenfeld, 1981; Green and Green, 1979; Achterberg et al., 1981; Brown, 1977).

The sympathetic nervous system (SNS) controls the vasoconstrictor response of the hands by intervating the smooth muscle cells of blood vessels. Vasoconstriction from SNS activity results in cold hands. Conversely, blood flow from vasodilation results in warm hands (Everly and Rosenfeld, 1981). In order to raise hand temperature one must reduce SNS firing which is controlled by the hypothalamus. The preoptic area of the hypothalamus has a major role in temperature regulation yet, wide spread areas of the cerebral cortex can effect vasomotor activity through the vasomotor center located in the pons and medulla where the degree of sympathetic vasoconstriction is controlled. Inhibiting this area causes vasodilatation and warmth in the extremities much like a surgeon who cuts sympathetic fibers to an area where vasodilatation is desired. With training, the cerebral cortex through conscious efforts can effect sympathetic tone (Guyton, 1976; King and Montgomery, 1980; Shaffer, 1982; Wentworth and Rohr, 1984).

Peripheral temperature variations were studied by Mittelman and Wolff (1939 and 1943) in people exposed to emotional stress during interviews. They found that under sustained stress, the subjects' finger temperature became close to that of the environment. In 1958, Graham, Stern and Winokur produced decreases in hand temperature in subjects given hypnotic suggestions associated with having Raynaud's disease. This was repeated by F. K. Graham and Kunish in 1965 but with less magnitude of temperature change when using attitude suggestions on nonhypnotized subjects. Boudewyns (1976) found that subjects in stressful situations (threat of shock) decreased finger temperatures and in relaxed conditions raised finger temperatures.

Decreases in skin temperature were greater than increases in nine subjects studied by Taub and Emurian (1976). Evidence of learning the skill was reportedly achieved after the fourth training session. Subjects reportedly used imagery, relaxation, commands to the hand and/or instrument light and self suggestion to produce the changes in skin temperature. Thermal imagery had been encouraged but no formal training was given. Taub and Emurian (1976) stressed strict control of ambient room temperature and extended baseline studies to aid in controlling internal factors such as emotions and external factors such as room temperature that can effect skin temperature.

Two studies by Surwit, Shapiro and Feld (1976) assessed auto regulation of digital skin temperature. The first study utilized eight female and eight male subjects assigned to two groups. One group's task was to raise skin temperature and the other to lower skin temperature given skin temperature feedback. No instructions were provided other than to relax and to think of their hand as either hot or cold. Two baseline days then five or nine days of training over a nine to nineteen day period followed to assess the effect of a greater number of training sessions. Results indicated that: 1) there was no significant difference in temperature changes between groups given five or nine days of training, 2) there was no significant change in respiration between sexes or groups, 3) the dominant hand was warmer than the nondominant hand but there was no significant difference in the ability to raise or lower temperature in either hand, and 4) women attempting to raise their hand temperature showed an increased heart rate where men showed a decreased heart rate with warming only. Averaging temperatures from both hands, the mean decrease was 2.0 $^{o}$C with the greatest being 10 $^{o}$C while the average increase was 0.25 $^{o}$C with the greatest being 3.5 $^{o}$C. Males and females did not differ in their ability to control skin temperature. No controls for effects of instruc-tion or monetary incentives were used. This experiment was done with the room temperature at 22.5 $^{o}$C. In the second experiment, the room temperature was lowered to 19.5 $^{o}$C which proved to hinder the subjects' performance rather than increasing the change in skin temperature when instructed to warm the hand.

Utilizing sixty female college students, Keefe (1978) assessed their ability to increase finger temperature under the following conditions in randomly assigned groups: 1) thermal suggestions with and without feedback, 2) rest instruction with and without feedback and 3) response specific instructions with and without feedback. The groups showing significant increases in digital skin temperature were those given feedback and thermal suggestion, feedback and response specific instruction and the group with thermal suggestion and no feedback. These groups maintained their ability to control skin temperature both one and two weeks after training. This study disproved the idea that skin temperature elevation may be due only to the vasodiliation associated with habituation to the experimental environment and instructions to "rest" alone.

Length of training was assessed by Keefe and Garden (1979). Two groups were compared, the first consisting of ten male subjects trained in finger temperature biofeedback for five consecutive days with ten minute training sessions. The second group consisted of six female subjects given twenty to thirty minute training sessions for five consecutive days. Half of each group attempted to decrease finger temperature, the other half attempted to increase finger temperature. Results indicated that subjects were unable to produce larger increases in temperature changes with more extended training; confirming Surwit et al.'s (1976) study.

Biofeedback training alone was compared with feedback in combination with slide projections and tape recorded suggestions on thermal imagery. Those subjects given formalized strategies for thermal imagery increased their skin temperature an average of $2.01^{o}$F after five baseline and eight training sessions, while the non suggestion group achieved an average increase of $0.73^{o}$F. The total number of subjects in this study was thirteen (Herzfeld and Taub, 1980). Thus, suggestion and thermal imagery is an important aid in teaching control of peripheral skin temperature. These findings confirmed an earlier study by Herzfeld and Taub (1977).

## Anxiety

Anxiety is a complex, multidimensional emotional reaction provoked by external or internal stimuli. The stimuli are perceived by the individual as threatening often envoking a stress response (Everly and Rosenfeld, 1984).

Spielberger, Gorsuch, and Lushene (1983) classified anxiety as either a relatively stable personality trait (a-trait) or a temporary state (a-state). Trait anxiety trait refers to one's susceptibility to developing state anxiety in response to a threatening stimulus. It may be viewed as an anxiety prone personality dimension which remains constant over time. Individuals with high levels of trait anxiety frequently view more stimuli as threatening and tend to react with greater state anxiety intensity (Spielberger, 1972).

State anxiety, however, is an emotional reaction evoked by a threatening situation (situational stressors). State anxiety varies in intensity and duration depending upon the individual's appraisal of the situation, coping mechanisms, and past experience with the type of situation. State anxiety fluctuates depending upon the situation at a particular time whereas trait anxiety is a constant personality factor (Spielberger, 1972).

Following a cardiac insult, patients' behaviors often includes anxiety, depression and fears of recurrence long into the convalescent stage of rehabilitation. Some of the major reasons for these behaviors include: fears of sudden death, angina, heart attack, blood clots, stroke, arrhythmias, becoming a cardiac cripple, losing their job or becoming unable to fulfill family roles. Many uncertainties exist regarding diet, activity, sex and medications that may produce anxiety along with certain life style changes needed such as to quit smoking, change one's diet and refrain from some activities or excitements. A loss of autonomy and independence may develop and family conflicts may increase primarily due to changes in life style. Fatigue, social alienation, diminished libido and dissatisfaction with life may develop. Anxiety and depression are the most common psychological symptoms following cardiac disease (Weise, et al., 1981; Ott et al., 1983; Hackett and Cassen, 1978).

The relationship between anxiety and finger temperature was studied by Crawford et al. (1977). Forty college students were randomly assigned to an anxiety group that discussed anxiety provoking situations and a pleasant group that discussed pleasant topics. Finger temperature was significantly decreased in the anxiety group during the discussion. No significant change was found in the pleasant group. Crawford et al.'s study indicated that anxiety can produce a decrease in skin temperature and that merely acclimating to a pleasant environment does not produce a significant change in skin temperature. Support for Crawford et al. (1977) can be found in an earlier study by Englhardt (1976) who reported significant reductions in general anxiety as measured by Spielberger's State-Trait Anxiety Inventory following six weeks of electromylograph (EMG) and temperature biofeedback training of thirty-two subjects.

In two separate studies a total of eighty psychiatric patients were treated with relaxation and temperature biofeed-back (Werbach et al., 1979; Hawkins et al., 1980). Both studies utilized Speilberger's State-Trait Anxiety Inventory and realized significant overall reduction in anxiety following treatment. Hawkins et al. (1980) could not correlate the anxiety reduction with changes in finger temperature but Werbach et al. (1979) reported a significant correlation existed between decreased anxiety and increased finger temperature for training groups with the opposite holding true for nontraining groups.

Bruno M. Kappes (1983) did an extensive study comparing the sequence of biofeedback and relaxation methods utilizing anxiety levels as a variable. Four groups received one of the following sequences: 1) temperature then EMG biofeedback; 2) relaxation training, temperature then EMG biofeedback training; 3) EMG then temperature biofeedback training; and 4) temperature, EMG then relaxation training. Thirty-seven subjects received sixteen twenty minute training sessions over an eleven week period. "Training was found equally effective for decreasing frontalis EMG and increasing finger temperature, regardless of sequence" (Kappes, 1983, p. 203). The most substantial improvement occurred after eight sessions, whereas little improvement was found after sixteen sessions. Each group became increasingly homogeneous over time on all measurements. Reductions in State and Trait anxiety were reported as well as a decrease in negative self attributes and somatic complaints. Kappes concluded that different methods of treatment can produce similar theraputic results.

A thought provoking study was done by Schandler and Dana (1983) which attempted to answer the question as to whether biofeedback training (EMG) was superior to imagery training in reducing physiological signs of tension as well as the psychological variables of state anxiety and other personality dimensions such as hostility and depression. Forty-five female college students were used as subjects. Results indicated that the EMG biofeedback group produced the largest reduction in physiological signs of tension yet the imagery group produced the largest improvement in the personality dimensions. The imagery group also exceeded the EMG biofeedback group in peripheral skin temperature measurements.

> "The data raise continued questions about the application of physiologically based operant relaxation procedures and support the use of cognitively mediated protocols for the treatment of specific or general anxiety behaviors." (Schandler and Dana, 1983, p. 672)

## Blood Pressure

An elevated blood pressure is a result of the stress response. The vasodilation from relaxation and thermal biofeedback therapy will result in a lowered blood pressure (Everly and Rosenfeld, 1984). Thus, in theory the proposed thermal biofeedback program will also benefit participants by lowering their blood pressure. However, the literature is limited in the number of studies using thermal biofeedback to lower blood pressure in patients with CHD. Thus, some related studies will be discussed.

Deep muscle relaxation, breathing exercises and meditation along with biofeedback of galvanic skin response were taught to ninety-nine industrial workers who exhibited two or more risk factors for coronary heart disease. Compared to a control group receiving no training the experimental group significantly reduced blood pressure along with reduced plasma renin activity and plasma aldosterone concentrations after eight weeks of treatment (Patel, Marmot and Terry, 1981). Many other studies have shown relaxation techniques to significantly decrease systolic and diastolic blood pressure (Patel, 1977; Taylor, 1977; Shoemaker and Tasto, 1975; Benson, et al., 1977). McGrady et al. (1981) used EMG biofeedback assisted relaxation in thirty-eight patients with essential hypertension. After eight weeks of training including relaxation exercises at home, statistically significant decreases in muscle tension, plasma aldosterone and urinary cortisol were found. They speculated that this reflected a reduction in the stress response mediated by the adrenal cortex.

A thirty-nine year old patient with diagnosed hypertension for over sixteen years taking Aldomet and Inderal in large quantities daily was referred for biofeedback treatment as a last hope before undergoing sympathectomy to the legs for blood pressure control. Over a six month training period all medications were discontinued and the patient's blood pressure remained normal after two years without medication.

Temperature and EMG biofeedback along with autogenic phrases and breathing exercises were used (Green and Green, 1979).

Remarkable results have occured using relaxation and biofeedback to treat patients with arterial occlusive disease. Greenspan et al. (1980) studied eleven patients with chronic arterial occlusive disease who had participated in an exercise program without improvement in symptoms. Patients were taught a modified Benson and Jacobson relaxation technique along with EMG and temperature biofeedback. After thirty one-hour training sessions over a thirteen week period, resting and exercise systolic blood pressure significantly decreased, maximum walking time increased and improvement in blood flow to the extremities occured. Following the study Greenspan et al. (1980) theorized that biofeedback has a generalized effect other than just reducing sympathetic tone in specific areas and may be effective in decreasing sympathetic tone in collateral blood vessels which is not seen following a sympathectomy. They suggested that biofeedback was an effective non-surgical intervention for selective patients with intermittent claudication and arterial occlusive disease.

## Angina

Briefly, angina is classified into two types: classical and variant. Both are the result of myocardial ischemia but for different reasons. Classical angina traditionally occurs when atherosclerotic narrowings of the coronary arteries limit myocardial blood flow in response to increased myocardial oxygen demand due to physical or psychological stress. Variant angina, however, results from a decreased blood flow to the myocardium due to vasospasm and may be unrelated to myocardial oxygen demand (Hall et al., 1983; Fuchs and Becker, 1982).

Common stimuli for classical angina include eating, extremes of temperature, exercise, emotions, and elevated heart rate and blood pressure (Hall et al., 1983; Segal et al., 1982). Factors that stimulate variant angina are poorly understood. These attacks have been found to occur at the same time each day, usually early morning and are rarely associated with elevated heart rate or blood pressure though intravenous administration of epinephrine may induce coronary vasospasm. Variant angina has also been known to occur following the cold pressor test (Fuchs and Becker, 1982). Many researchers believe the mechanism for vasospasm is from a local sympathetic nerve response rather than from a generalized sympathetic nervous system response (Fuchs and Becker, 1982).

The literature is extremely limited in the number of studies using thermal biofeedback for angina control. Only the following two reports were found. A case report by C. H. Hartman (1979) described a patient with chronic angina who learned hand warming and was able to ease the pain, greatly reduce the need for nitroglycerin and nitrobid, then eventually stopped taking the drugs altogether. The patient learned to prevent angina by sitting down and warming his hands whenever he sensed tightness in his chest. Hand warming was then taught to two other patients with the same results. Beneficial results of this therapy continued over several years strongly suggesting a direct relationship between the angina pain and peripheral vasoconstriction reflected by finger temperature.

Nakamura et al. (1984) studied the response of forearm blood vessels in patients with variant angina to cold pressor and mental stress. Control and experimental groups consisted of ten subjects each. In the angina group forearm vessels showed abnormal reflex vasoconstriction to the cold pressor test in comparison to the control group leading the researcher to conclude that there is a generalized abnormality of the vascular smooth muscle or its neural control in some patients with variant angina. Miller et al. (1981) found a high incidence of migraine and Raynauds phenomena in patients with variant angina. Obviously there is a conflict as to whether coronary vasospasm is a local or generalized response. If it is a generalized response, then teaching patients vasodilatation through thermal biofeedback may decrease the frequency and/or duration of angina attacks.

Several questions have been answered as well as raised in the literature reviewed to support the theoretical framework. Much controversy clearly exists, especially in methodology. Thus, in an effort to summarize, all of the following will be taken into consideration for development of the methodological design described in chapter three:

1) The dominant hand is usually warmer than the non dominant hand.

2) Finger temperature control can be taught with increases more difficult to obtain than decreases.

3) Emotional stress or anxiety can cause a decrease in finger temperature.

4) It is controversial whether increased finger temperature significantly correlates with decreased anxiety and whether an increased finger temperature reflects relaxation.

5) Controversy exists as to whether temperature biofeedback helps increase finger temperature better than imagery or relaxation alone.

6) Greater amounts of training time and number of sessions do not result in greater increases in finger temperature, suggesting a plateau effect.

7) Different methods of biofeedback and relaxation training over a period of time may result in similar theraputic effects.

8) Relaxation with biofeedback training has been shown in one study to reduce risk factors of coronary heart disease.

9) Controversy exists as to whether temperature biofeedback has any greater effect in reducing anxiety than relaxation training alone.

10) A question is raised as to whether vasodilation of the hands reflected by increased finger temperature is related to vasodilation of coronary arteries reflected by decreased angina.

11) A question is raised as to whether peripheral vasodilation reflected by increased finger temperature reflects a decrease in sympathetic tone.

12) The majority of studies suggest that relaxation training in combination with biofeedback (temperature, EMG, or both) has a greater effect in producing relaxation than relaxation training alone.

## Summary

In conclusion, this chapter illustrates the opposing effects relaxation has on the stress response. The stress response can lead to elevations in blood pressure and anxiety level and may precipitate an angina attack in patients who suffer from angina. This can be devastating to patients with cardiovascular disease possibly increasing the morbidity and mortality of the disease. Thermal biofeedback therapy promotes relaxation, lowers blood pressure and anxiety levels and may decrease the frequency of angina attacks thus improving the psycho-physiological state of the patient. Overall, the literature supports these findings though some controversy exists. Taking all factors into consideration, the implementation of thermal biofeedback therapy into a cardiac rehabilitation program should benefit the patient in terms of the aforementioned variables.

# CHAPTER 3

# METHODOLOGY

The study was designed to investigate the effects of thermal biofeedback therapy on blood pressure, anxiety and the frequency of angina attacks in patients with coronary artery disease who were participating in a cardiac rehabilitation program. Methods for data collection and analysis are described in detail in this chapter.

## Design

An experimental design was utilized to investigate the effects of thermal biofeedback therapy on the aforementioned variables. Subjects who volunteered to participate were to be randomly assigned to control and experimental groups.

## Setting

Initial contact and recruitment of subjects occurred at four established cardiac rehabilitation centers in a southwestern city. Preliminary screening and baseline data collection was conducted at the centers or by telephone. A classroom was used to administer the anxiety test to the control group. The thermal biofeedback therapy was conducted in a room within the behavioral studies laboratory at a southwestern college of nursing. Anxiety tests were administered to the experimental group in this laboratory.

## Sample

A convenience sample of twenty subjects was recruited from participants in the cardiac rehabilitation program. The criteria for selection were:

1. Diagnosis of coronary artery disease
2. Current history of angina
3. No history of insulin-dependent diabetes
4. Not currently taking any beta adrenergic blocking agents
5. Able to speak and read English
6. Non smoker
7. No history of chronic or acute psychiatric disease
8. No prior training in thermal biofeedback

A diagnosis of coronary artery diseease with a current history of angina and participation in a cardiac rehabilitation program was required to meet the focus of this study. Diabetics and patients taking beta adrenergic blocking agents were excluded from the study due to possible side effects relating to Insulin need and bradycardia known to occur with relaxation training (Benson, 1977; Hoffman et al., 1982). Patients' medical records were examined to determine medication use and presence of insulin-dependent diabetes.

Smoking causes vasoconstriction, may increase heart rate and blood pressure and may aggravate angina (Phipps, Long and Woods, 1983; A.H.A., 1977). Thus only non-smokers were included in the study.

The absence of chronic or acute psychiatric disorders limited the possibility of altering the anxiety variable in favor of factors unrelated to cardiovascular disease. Psychiatric status was determined by self report and examination of medical records. No physical or psychological exam was given to the subjects. Subjects who had had prior training in thermal biofeedback were excluded from the study to avoid bias in that respect.

All subjects were requested to fast from food and drink (except water) for two hours prior to thermal biofeedback therapy. This eliminated any relaxant or stimulating effect that food or drink may have on the body. Subjects were also instructed to fast for two hours prior to the exercise training so the blood pressure data collected was under the same conditions. Fasting before exercise was required by the rehabilitation program.

Potential subjects were presented with the selection criteria at the time of recruitment. A willingness to participate in the study was considered self report evidence of compliance with the selection criteria. Medication, diabetic and psychological status were determined by the medical record.

## Protection of Human Subjects

The research proposal describing the purpose and design of the study was be presented to the University of Arizona Human Subjects Committee. After approval, access was obtained from the medical directors of the cardiac rehabilitation programs. Then recruitment of subjects began (see Appendix A). During recruitment, potential subjects were given a disclaimer explaining the purpose and methodology of the study (Appendix B). The disclaimer informed the subjects of their right to withdraw from the study at any time without incurring ill will. Opportunity for questions was given at the time of recruitment. Each subject was assigned a code number to assure anonymity and confidentiality. Only the primary investigator had access to subject's identification code number.

## Data Collection Procedure

Group meetings were held at the cardiac rehabilitation centers to explain the purpose and requirements for the study. Posters advertizing the study were displayed at the centers to recruit volunteers to the meeting. Volunteer subjects meeting selection criteria were to be randomly assigned to control and experimental groups consisting of ten participants each. Due to a lack in number of volunteer subjects for the experimental treatment group, a. nonrandom sample was used. Instead subjects were recruited for the experimental group. A group of patients at one cardiac rehabilitation center served as the control group. The control group met at an agreed upon time for the administration of the A-State and A-Trait Scale from the STAI entitled "Self-Evaluation Questionnaire" and for the distribution of Angina Flow Charts (Appendix C). The experimental group met separately with the investigator for an explanation of their role in the study and administration of the anxiety test. Participants were provided with the investigator's phone number to allow them an opportunity to have questions answered. Thermal biofeedback training for the experimental group was conducted as outlined in Appendix D. The entire program including blood pressure data collection continued for six weeks. Subjects in the experimental group were required to complete eight sessions of thermal biofeedback training at a rate of two sessions per week for a total of 4 weeks. Each session lasted approximately thirty minutes with fifteen minutes of actual training time per session. A daily flow chart for thermal biofeedback training and home practice handouts were distributed to the experimental group (Appendix E and F). All training and data collection during thermal biofeedback therapy was done by the primary investigator.

After reviewing the procedure with the primary investigator, blood pressure data were collected by experienced employees at the cardiac rehabilitation centers. A series of three different measures on different days was averaged to obtain systolic and diastolic pressures. Blood pressure data were collected the week before and the week after the thermal biofeedback training was completed. The STAI was repeated for both groups within one week following completion of the training program (Appendix D).

## Instruments

### Thermometer

A Digitek 58-10 digital thermometer with a dual thermister probe was utilized for thermal biofeedback training. Temperature is digitally displayed in degrees celsius to the hundredth degree. Calibration to eliminate mechanical error was performed by the biomedical department at a Southwest University Hospital. Following the five minute acclamation period, temperatures were recorded by the investigator once per minute for the fifteen minute training period. These readings were used to assess patient progress and provide another means for feedback. They were not used for data analysis since the degree of temperature change by the subject was not the focus of this study.

Many physical and technical factors can influence skin temperature. These include environmental temperature, airflow, exercise, muscle tension, disease processes, basal metabolic rate, ingestion of food, clothing, attachment of sensor, and possible heat production from thermally conductive wires in the biofeedback unit itself. Blood volume, state of hydration, posture, limb position have also been cited as influential on peripheral skin temperature (Taub and School, 1978; Dubois, 1941).

Environmental temperature was controlled at sixty-eight degrees fahrenheit plus or minus two degrees. Attachment of the sensor was the same for all subjects. The sensor was taped to the index finger of the dominant hand and not be allowed to rest against any material or body part. The hand was kept in the same position throughout the session to eliminate exercise and positional influence on temperature. Subjects were instructed not to eat or drink (except water) for two hours prior to the sessions. Heavy clothing was removed. Oral temperatures were recorded at the beginning of each session using a standard mercury thermometer to detect any fever which may indicate a disease process and/or change in metabolic rate (Guyton, 1976). Blood volumes and state of hydration were not controlled. These controls were in effect mainly to provide the subjects with more accurate feedback.

G-25A GSR/Temp. #12223

The G-25A is a biofeedback machine manufactured by J & J Enterprises. It provides visual and audio temperature feedback. The machine is new, calibration and testing was completed by the manufacturer. The G-25A was purchased utilizing funds from a research stipend provided by the American Heart Association.

Subjects use of the machine involves taping the temperature sensor to the middle finger of the dominant hand. Care was taken so that the sensor did not come in contact with the Digetek probe or wires. The reason for use of both machines was that the G-25A did not provide temperature readouts to the hundreth degree as does the Digetek. This greater specificity of degree in temperature provided better feedback for the subjects and made it easier for their progress to be assessed.

The primary investigator was responsible for operating the G-25A and Digetek machines. She was present with the subjects during the entire training session. Proper use of the equipment was assured by an instructor certified in biofeedback training who had also instructed the primary investigator in biofeedback therapy and served as a consultant throughout this investigation.

The G-25A provides feedback in two different manners: visual and auditory. Visual feedback consists of a series of lights progressing from left to right. The light moves to the right as temperature increases and to the left as temperature decreases. The Digetek provided visual feedback by a digital display of temperature to the hundreth degree. Auditory feedback from the G-25A consists of a clicking sound produced when temperature decreases. The sound goes off as temperature increases. Subjects were instructed to try to silence the clicking sound. With each advance in temperature, a new threshold is set so that auditory feedback is given when a decrease in current temperature is sensed.

Stress Control Biofeedback Card

For home practice, each subject in the experimental group was given a "stress control biofeedback card" distributed by the Stens Corporation. The card contained a temperature sensitive area that when held gently in the hand changed color according to hand temperature. Black to red color indicated approximately 86 $^{o}$F; green indicated approximately 92 $^{o}$F; and blue indicated approximately 98 $^{o}$F. The main purpose for providing subjects with these cards was to facilitate and encourage home practice. Results from the use of these cards was not included in the data analysis.

Sphygmomanometer

Blood pressure was measured by experienced employees at the cardiac rehabilitation centers utilizing a mercury sphygmomanometer and a diaphragm stethoscope. Blood pressure was measured with the subject standing per routine at all the rehabilitation centers with the cuffed arm at heart level. Blood pressures were measured prior to exercise and at least two hours after eating and drinking (except for water). Three blood pressures (systolic and diastolic) were obtained before and after the biofeedback training program from both control and experimental groups. The average of each set of three measures was utilized for statistical analysis. Blood pressures were measured at least twenty-four hours apart. Both systolic and diastolic pressures were used for data analysis. Systolic blood pressure was measured in mmHg where the first sound was heard as the cuff was deflated at a rate of 2 mmHg per second. The diastolic measure was the point at which the sound disappeared or became muffled. Due to the need to use four different cardiac rehabilitation facilities, one nurse was unable to take all the subjects' blood pressures. Interrater reliability was not established. Blood pressure measurements were taken from the medical records, thus introducing the possibility of error which will be addressed later.

State-Trait Anxiety Inventory (STAI)

Spielberger, Gorsuch and Lushene (1967) developed the STAI (revised in 1980) for the measurement of both state and trait anxiety by utilizing an easily administered self report questionnaire. The inventory consists of two twenty item scales one measures state and the other trait anxiety. Directions for use are written on the scale. Instructions for administration were followed as directed in the STAI Manual (Speilberger et al., 1983). State anxiety scores reflected the level of anxiety experienced by the subjects at the time the test was administered. Both state and trait anxiety tests were administered since changes have been seen in each (Hawkins et al., 1980; Englhardt, 1976; Knappes, 1983). Trait anxiety scores reflected the subject's overall or general anxiety level.

Numerous studies with high school, college and patient populations have utilized the STAI documenting its construct validity and demonstrating internal consistancy for both the state and trait scales. A list of these studies is provided in the STAI manual (Spielberger et al., 1983). However, no studies utilizing cardiac rehabilitation patients were found.

Angina Flow Chart

The Angina Flow Chart which was incorporated into the Daily Flow Chart for Thermal Biofeedback Training (Appendix C and E) is a self report instrument designed to estimate the frequency of angina attacks by the subjects. Subjects were provided with directions for completing the flow charts and instructed to do so on a daily basis. Heart rates recorded on the flow charts were not used for data analysis. Flow charts were collected at the end of each week for a total of five weeks. A trend plot diagram was to be utilized to reflect the average number of angina attacks per day per group for comparison. Self report bias influenced the accuracy of the angina flow chart. Error in interpretation of instruction, recording of actual occurances or perceived social desirability in reporting as well as possible placebo effect from the biofeedback training were all factors to be considered (Polit and Hungler, 1983).

Demographic data included: Age, diagnosis, length of time with diagnosis, length of time in cardiac rehabilitation program, and frequency of angina. This information was obtained by a questionnaire given with the first state-anxiety test and from the medical record.

## Data Analysis Plan

The demographic data was analyzed using descriptive statistics. Frequencies, means and standard deviations were calculated for age, diagnosis, length of time with heart disease and length of time in the cardiac rehabilitation program. Blood pressures, anxiety scores and frequency of angina attacks were illustrated in the same manner.

Null Hypothesis

The null hypotheses tested were:

1. There is no difference in blood pressure between a group of subjects in a cardiac rehabilitation program who have received thermal biofeedback therapy (experimental group) and a group of subjects who have not received thermal biofeedback therapy (control group).
2. There is no difference in state anxiety between a group of subjects in a cardiac rehabilitation program who have received thermal biofeedback therapy (experimental group) and a group of subjects who have not received thermal biofeedback therapy (control group).
3. There is no difference in frequency of angina attacks between a group of subjects in a cardiac rehabilitation program who have received thermal biofeedback therapy (experimental group) and a group of subjects who have not received thermal biofeedback therapy (control group).

Inferential statistics using independent t-tests were employed to ascertain if there were significant differences between groups for the variables measured. A significance level of 0.05 was set.

## Summary

This chapter has explained the experimental design employed to assess the effect of implementing thermal biofeedback therapy in a cardiac rehabilitation program. It was predicted that there would be a significant decrease in blood pressure, anxiety and frequency of angina attacks in the experimental group following therapy as opposed to the control group who did not receive thermal biofeedback therapy.

CHAPTER 4

# RESULTS OF DATA ANALYSIS

This chapter describes the results of the data analysis. Sample characteristics and comparisons of pre and post measures from the control and experimental groups are included.

## Description of Sample

The entire sample consisted of twenty volunteer subjects solicited from four different cardiac rehabilitation centers and one adult fitness program within a southwestern city. Five males and five females were in the control group. Nine males and one female were in the experimental group. Members of the adult fitness program who met selection criteria were recruited for the study due to difficulties in obtaining subjects solely from the cardiac rehabilitation programs. Thus, a convenience sample was used with no random assignment into groups.

All subjects in the control group were from one cardiac rehabilitation program. Three subjects in the experimental group came from this same program, two were from another program and five were members of the adult fitness program at a local university. Subjects in the adult fitness program had been diagnosed with coronary artery disease a greater length of time and had spent more time in cardiac rehabilitation. The length of time in adult fitness was used for length of time in cardiac rehabilitation for those subjects to whom it applied.

Table 1 summarizes the distribution of age, length of time with diagnosis and length of time in cardiac rehabilitation.

The control group had two subjects who had experienced myocardial infarctions, three with arteriosclerotic heart disease and five who had received artery bypass grafts. The experimental group had five subjects who had experienced myocardial infarctions, two with arteriosclerotic heart disease and three who had received coronary artery bypass grafts. Two members from both groups had myocardial infarctions prior to their bypass grafts. Thus, the majority of subjects in this study had experienced a myocardial infarction.

## Hypothesis Testing

The null hypotheses were tested utilizing independent t-tests with a significance level set at 0.05. Each hypothesis is discussed separately.

### Hypothesis One

The null hypothesis tested was: there is no significant difference in blood pressure between a group of subjects in a cardiac rehabilitation program who received thermal biofeedback therapy (experimental group) and a group of subjects who did not receive thermal biofeedback therapy (control group). Systolic and diastolic blood pressures were tested separately. The mean of three readings was used for comparison between groups. No significant difference ($t = 1.34$ and $t = -0.34$) was found for the pre test systolic and diastolic blood pressures indicating the groups did not differ significantly at baseline (see Table 2). No significant difference ($t = 1.45$) was noted in the

TABLE 1

Comparison of Control and Experimental Groups
on Selected Demographic Variables

| Variable | Mean | Standard Deviation | Range |
|---|---|---|---|
| CONTROL GROUP | | | |
| Age in Years | 65 | 12.55 | 50-84 |
| Length of Time with Diagnosis (months) | 21.2 | 14.86 | 3-102 |
| Length of Time in Cardiac Rehabilitation (months) | 2.3 | 3.66 | 1-7 |
| EXPERIMENTAL GROUP | | | |
| Age in Years | 60.8 | 11.61 | 44-79 |
| Length of Time with Diagnosis (months) | 49.5 | 49.39 | 5-156 |
| Length of Time in Cardiac Rehabilitation (months) | 34.4 | 47.18 | 2-156 |

TABLE 2

Significant Differences Between Control and Experimental Groups on Pretest, Posttest Systolic and Diastolic Blood Pressures: Independent t-tests, N = 20

| Variable | N | Mean | Standard Deviation | t-value |
|---|---|---|---|---|
| Systolic Blood Pressure Pretest | | | | |
| Control Group | 10 | 132.50 | 11.31 | |
| Experimental Group | 10 | 123.66 | 17.43 | 1.34 (NS) |
| Diastolic Blood Pressure Pretest | | | | |
| Control Group | 10 | 71.77 | 5.91 | |
| Experimental Group | 10 | 73.13 | 11.17 | -0.34 (NS) |
| Systolic Blood Pressure Posttest | | | | |
| Control Group | 10 | 141.30 | 13.30 | |
| Experimental Group | 10 | 117.50 | 16.90 | 3.49 * |
| Diastolic Blood Pressure Posttest | | | | |
| Control Group | 10 | 75.73 | 5.58 | |
| Experimental Group | 10 | 69.93 | 11.35 | 1.45 (NS) |

* = Significant at p <= 0.05
NS = Non Significant

post test diastolic blood pressure indicating there was no significant difference in diastolic blood pressure between the two groups following the biofeedback treatment to the experimental group. There was a significant difference between groups for the post test systolic blood pressure indicating the groups differed following application of the independent variables ($t = 3.49$; see Table 2). Therefore, the null hypothesis was rejected for post test systolic blood pressure.

### Hypothesis Two

The null hypothesis tested was: there is no significant difference in state anxiety between a group of subjects in a cardiac rehabilitation program who received thermal biofeedback therapy (experimental group) and a group of subjects who did not receive thermal biofeedback therapy (control group). Pre and post test state anxiety t-values were $t = 1.31$ and $t = 0.73$ indicating no significant difference between the experimental and control groups (see Table 3). Therefore, the null hypothesis for state anxiety could not be rejected. Trait anxiety was also tested and no significant difference was found between control and experimental groups pre and post tests ($t = 0.36$ and $t = 0.96$).

### Hypothesis Three

The null hypothesis tested was: there is no significant difference in frequency of angina attacks between a group of subjects in a cardiac rehabilitation program who received thermal biofeedback therapy (experimental group) and a group of subjects who did not received thermal biofeedback therapy (control group). Due to lack of

TABLE 3

Significant Differences Between Control and Experimental Groups on Pretest, Posttest, State and Trait Anxiety Scores: Independent t-tests, N = 20

| Variable | N | Mean | Standard Deviation | t-value |
|---|---|---|---|---|
| State Anxiety Pretest | | | | |
| Control Group | 10 | 32.80 | 10.49 | |
| Experimental Group | 10 | 28.00 | 4.97 | 1.31 (NS) |
| Trait Anxiety Pretest | | | | |
| Control Group | 10 | 37.80 | 15.58 | |
| Experimental Group | 10 | 35.80 | 8.26 | 0.36 (NS) |
| State Anxiety Posttest | | | | |
| Control Group | 10 | 35.30 | 14.48 | |
| Experimental Group | 10 | 31.30 | 9.71 | 0.73 (NS) |
| Trait Anxiety Posttest | | | | |
| Control Group | 10 | 41.00 | 15.90 | |
| Experimental Group | 10 | 35.50 | 8.62 | 0.96 (NS) |

NS = Non Significant at p = 0.05

subjects experiencing angina, this hypothesis was not able to be tested, as only three subjects reported angina.

## Secondary Data Analysis

Further analysis was undertaken to test for significant differences between pretest and posttest blood pressure measurements and anxiety scores in the experimental group. The analysis was undertaken to ascertain if any changes occurred within the group receiving thermal biofeedback therapy. Dependent t-tests were computed. A significant difference was found for both systolic and diastolic blood pressure ($t = 3.36$ and $t = 3.05$; see Table 4) indicating blood pressure significantly decreased following the therapy. No significant differences ($t = -1.13$ and $t = 0.34$) were found for the state and trait anxiety variables indicating anxiety scores did not change following the therapy (see Table 4).

## Subject Evaluation of the Thermal Biofeedback Therapy

A program evaluation was given to the participants in the experimental group who received thermal biofeedback (see Appendix H). Of the nine participants who completed the evaluation, seven stated that they would like to continue the program, one thought possibly and another said "no" primarily because he was seeking help with chronic headaches. All stated they planned to continue practicing the relaxation techniques following completion of the study. All also indicated they would like to see thermal biofeedback become part of their cardiac rehabilitation program. Benefits expressed by the subjects included: a) easier to relax, b) more self control, c) greater awareness of need

TABLE 4

Significant Differences Within the Experimental Group Between Pretest and Posttest Blood Pressure and Anxiety Variables: Dependent t-tests, N = 10

| Variable | Mean | Standard Deviation | t-value |
|---|---|---|---|
| Systolic Blood Pressure | | | |
| Pretest | 123.67 | 17.43 | |
| Posttest | 117.53 | 16.92 | 3.63 * |
| Diastolic Blood Pressure | | | |
| Pretest | 73.13 | 11.17 | |
| Posttest | 69.93 | 11.35 | 3.05 * |
| State Anxiety | | | |
| Pretest | 28.00 | 4.97 | |
| Posttest | 31.30 | 9.71 | -1.13 (NS) |
| Trait Anxiety | | | |
| Pretest | 35.80 | 8.26 | |
| Posttest | 35.50 | 8.62 | 0.34 (NS) |

* = Significant at p <= 0.05
NS = Non Significant

to relax, d) less upset over minor occurences, and e) an ability to reduce heart rate while under physical strain. One person did not report any benefit. Suggested changes in the program include: a) lengthen or make the program more concentrated, b) give the subjects something to help them see their progress at home, and c) utilize a site more convenient to the cardiac rehabilitation center. Four subjects stated they would make no changes. The overall response from the participants in this program was very positive.

## Summary

Three hypotheses were tested to analyze if significant differences in systolic and diastolic blood pressure and state and trait anxiety existed between a group of subjects who had undergone thermal biofeedback therapy and a control group who had not received the therapy. The null hypotheses for diatolic blood pressure, state anxiety and trait anxiety were accepted. The null hypothesis for systolic blood pressure was rejected. Secondary analysis was conducted for significant differences on pre and post systolic and diastolic blood pressure and state and trait anxiety scores for the experimental group utilizing a dependent t-test. Significant differences were found between pre and post test blood pressure measures, but not state and trait anxiety scores. Subject evaluation by the participants in the thermal biofeedback program was favorable.

CHAPTER 5

# DISCUSSION OF RESULTS

In the last chapter, conclusions drawn from the results of the data analysis are discussed. Implications for nursing practice and limitations of the study are presented. Suggestions for further study are recommended.

## Blood Pressure Measurements

Pretest systolic and diastolic blood pressures were not significantly different indicating that the control and experimental groups were similar in terms of baseline blood pressure. Post test systolic blood pressure was significantly different between the two groups. Thus, the null hypothesis was rejected in terms of systolic blood pressure. A significant decrease in systolic blood pressure was reported by Greenspan et al. (1980) following thermal biofeedback therapy. Green and Green (1979); Patel, Marmot and Terry (1981) and McGrady et al. (1981) reported significant decreases in both systolic and diastolic blood pressures post biofeedback and relaxation therapy. This study substantiates those findings for systolic blood pressure. In terms of post intervention diastolic blood pressure comparisons, no significant difference was found between the two groups. This finding did not concur with the literature cited above. Perhaps a larger sample size or an increased intervention time would make a difference. Based on a review of the literature, Jacob (1984) stated that three to six months of therapy would be necessary to adequately assess the effects of relaxation therapy on blood pressure. An earlier review by Williamson and Blanchard (1979) stated that extended training time is beneficial for producing greater changes in blood pressure. Studies by Greenspan et al. (1980) and Patel, Marmot and Terry (1981) utilized training periods of eight weeks. This study was conducted over a four week period.

Comparison of experimental intragroup changes in blood pressure revealed significant differences between pre and post test measures for both systolic and diastolic blood pressures. This finding is similar to the aforementioned studies. When interpreting the results of the blood pressure measures, the fact that use of antihypertensive medications was not taken into account must be considered. Verbal reports and examination of medical records revealed that three persons in the control group and two persons in the experimental group were taking antihypertensive medications. Aldomet and Catapres reportedly were used as well as other drugs which are not first-line antihypertensive agents but may indirectly alter blood pressure i.e. Nitrobid, Cardizem and various diuretics. Only one person in the experimental group reported making changes in an antihypertensive medication. No changes were reported in the control group. Since few changes were made over the course of this study it is assumed that the use of antihypertensive medications had little effect on the results of this study. One must consider, however, that the blood pressure in the control group increased over the course of the study. The effects this may have had on the results of the study will be discussed later.

## Anxiety Measurements

Both state and trait anxiety were measured. The null hypotheses for both state and trait anxiety were accepted indicating there was no significant difference between the groups in anxiety measures both pre and post intervention. This was also true for the secondary analysis of pre and post measures within the experimental group. The results of previous research showed that relaxation and biofeedback therapy reduce state and trait anxiety. Reports of reductions of state anxiety were more common than those for trait anxiety (Kappes 1983; Englhardt 1976; Werbach et al. 1979; Hawkins et al. 1980). Possible causes for findings in the present study might be: a) the short time period (four weeks) over which the intervention occurred; b) an older population tends to score lower on these tests making for less varience in scores (Spielberger et al. 1983); and c) the social desirability response. Knappes (1983) conducted a study over an eleven week period, Schandler and Dana's (1983) study was over a nine week period, Crawford et al. (1977) conducted their study over a six week period and Hawkins et al. (1980) utilized ten forty minute training sessions in their study. All of these studies were conducted over a greater period of time than the present research and all realized significant decreases in anxiety levels. Thus, an increase in intervention time may result in significant decreases in anxiety levels. Mean scores published by Spielberger et al. (1983) for general medical and surgical patients (no age given) on state and trait anxiety were 42.68 and 41.33 respectively. Mean scores for working adult males age 50-69 were 34.51 and 33.86. Working adult female scores were slightly lower. No scores were published for subjects in cardiac rehabilitation programs. The mean scores for this researcher's group of subjects (see Table 3) are closer to those of the working adults age 50-69. Spielberger et al. (1983) states that age can make a significant difference in anxiety scores which may explain in part the lack of significant varience in the anxiety scores, as the scores were close to the norms to begin with.

The studies cited above utilized mostly college students. In the present research, anxiety scores increased from pre to post test measures. Perhaps upon second testing the subjects were more open to expressing their true feelings. However, the increase in anxiety does not correlate with the literature review. Also, some subjects may have answered the questionnaire as they thought they should as opposed to how they really felt i.e. the social desirability response (Polit and Hungler 1983). Therefore, the results may not have been accurate.

## Nonrandom Assignment of Groups

Differences between the control and experimental groups must be considered when interpreting the results of this study. Potential weaknesses due to the nonrandom assignment of groups are presented in this section.

The first major difference between groups was the length of time with coronary artery disease and the length of time in cardiac rehabilitation. Shorter times for the control group would effect their ability to cope with the disease from both a physiologgical and psychological standpoint. Increased time in exercise and comradity at the rehabilitation center has been known to facilitate coping with the stress often associated with coronary artery disease (Hellerstein, 1979; Kolman, 1983). Ideally, had this been a major discrepency between the groups, the pretest anxiety measures would have been significantly different but they were not.

Secondly, while a significant difference was found between groups in post therapy blood pressures, it must be realized that while the experimental group decreased in blood pressure, the control group increased in blood pressure. Factors at the cardiac rehabilitation center, unknown to this researcher may have influenced this variable. Perhaps the increase within the control ggroup could be a reflection of the stress factor associated with newly diagnosed coronary artery disease discussed above. Since few changes in medications were reported for either group there is doubt that antihypertensive medication played a role in this change either. Consequently, a posthypothesis testing was done on blood pressures within the experimental group (Table 4) which revealed significant differences between pre and post test measures thus dismissing the increase in blood pressures within the control group as the major factor resulting in the significant difference reported in Table 2.

The third major difference between the groups was the thermal-biofeedback therapy. Did the therapy result in a decreased blood pressure for the experimental group? So as not to adversely effect subjects medical care, subjects nor their physicians were requested to refrain from making changes in medications during the course of study. Only one person in the experimental group reported changes in antihypertensive medications. Since this subjects change in blood pressure was less than the group average, it is not believed that results were misconstrued by the medication changge. The following is a brief description of events which occured within the experimental group as a result of the termal biofeedback therapy.

Excluding the first two introductory sessions, subjects in the experimental group averaged a 2.15 $^{o}$F increase in finger temperature ranging from -3.35 to 6.39 $^{o}$F. An exception not included in this average was a 9.9 $^{o}$F increase from a subject who had vascular insufficiency in one hand. For this reason, the other hand was used for thermal biofeedback therapy. However, on one occasion the affected hand was used resulting in this remarkable increase in temperature. The subject stated that as a result of the therapy, that hand was warmer on a day to day basis than it had been in over ten years. A baseline temperature difference of 1.6 $^{o}$F existed between the two hands.

Negative temperatures were from subjects unable to raise their finger temperature at will, finding it stressful to attempt to do so. Often, however, these subjects would have finger temperatures above baseline during conversation with the researcher. Being unable to relax at will, these subjects when finding themselves in a stressful situation, were encouraged to talk with someone. Hopefully, with further training they would be able to raise their finger temperature at will. Subjects able to raise their finger temperature at will were encouraged to do so when in a stressful situation.

Subject evaluations of the thermal biofeedback program were very positive. Personal comments reflecting a change in their reaction to a stressful situation emphasized the value of the therapy. For example, one subject reported that while driving to exercise class he realized he had forgotten something. His previous behavior would have been to pound his hand on the steering wheel, curse, and angerly turn the car around. However, following the biofeedback and relaxation therapy plus his increased awareness about the adrenal response, he was able to tell himself, "Oh well, I guess I'll just be late for class" after which he calmly turned the car around. This form of behavior change occured in other subjects which supports the effectiveness of the program. Therefore, it is believed that the thermal biofeedback therapy influenced the decrease in blood pressures within the experimental group. The nonrandom assignment of groups could not have altered this result.

## Implications for Nursing Practice

As stated in chapter one, prevention and reduction of the morbidity and mortality of coronary heart disease depends on the reduction of risk factors. Hypertension and an anxious or coronary prone personality are two of these risk factors. Nurses actively involved in preventative and restorative care need to be involved in teaching patients how to reduce their risk for heart disease. Thermal biofeedback and relaxation therapy were shown to significantly reduce diastolic blood pressure in this study as well as others. Also, although the anxiety measures were not significantly decreased, the written evaluation from participants completing the biofeedback program indicated that the majority of subjects felt "more relaxed". It is interesting to note that the average blood pressure of the experimental group was not high (124/73, see Table 2) indicating that the therapy was beneficial to subjects who were not hypertensive. Thus, for improvement of patient care in cardiac rehabilitation programs, implementation of thermal biofeedback and relaxation therapy is recommended to assist in improving the patients quality of life from a psychological as well as physical standpoint.

## Limitations

The following limitations have been identified:

1. A small sample size.
2. The use of nonrandom assignment to control and experimental groups with the control group from one cardiac rehabilitation program.
3. The short time span over which the intervention strategy was conducted.
4. A potential social desirability response in responding to the anxiety questionnaire as well as to the written evaluation in the experimental group.
5. Lack of control over any antihypertensive drugs the subjects may have been taking.
6. Possible errors in blood pressure measurements. Blood pressures were not all taken by the same person, and measurements recorded in medical records were used.
7. Wide variability of subjects in length of time in a cardiac rehabilitation program.
8. Use of multiple t-tests increasing the possibility of making a Type I error i.e. rejecting a true null hypothesis (Reid, 1983).

## Suggestions for Future Research

Suggestions for further nursing research include:

1. Replicate the study with a larger sample size.

2. Replicate the study with subjects from the same cardiac rehabilitation facility.
3. Stricter controls over blood pressure measurements. Having all readings taken by the same person to decrease multirater error.
4. Stricter controls over antihypertensive medications. Either eliminate subjects on antihypertensive drugs from the study or maintain accurate record of changes in medications.
5. Lengthen the intervention time.
6. Randomly assign subjects to experimental and control groups.
7. Testing other variables such as serum cholesterol, serum catacholamines, plasma aldosterone or urinary cortisol. Elevation of these variables reflects activation of the stress response (Dimsdale et al., 1983 and McGrady et al., 1981).

## Summary

In summary, the study examined the difference in blood pressure and anxiety levels between subjects in a cardiac rehabilitation program who received thermal biofeedback therapy and those who did not. Post test systolic blood pressure was found to be significantly different between the two groups following application of biofeedback therapy to the experimental group. Additional analyses comparing pre and post measures of blood pressure and anxiety levels within the experimental group revealed a significant difference in systolic and diastolic blood pressures between pre and post tests. These findings substantiated previous research on blood pressure changes following biofeedback and relaxation therapy. No significant difference was found in any of the anxiety measures which does not concur with previously cited research findings. The implication for nursing practice cited is the need to implement psychological in addition to physical training in cardiac rehabilitation programs to facilitate a reduction in the mortality and morbidity from coronary artery disease.

# APPENDIX A

## HUMAN SUBJECTS COMMITTEE APPROVAL

THE UNIVERSITY OF ARIZONA
HEALTH SCIENCES CENTER
TUCSON, ARIZONA 85724

HUMAN SUBJECTS COMMITTEE
1609 N WARREN (BUILDING 220), ROOM 112

TELEPHONE (602) 626-6721 or 626-7575

7 May 1986

Nancy L. Jarkowski, R.N.
College of Nursing
Arizona Health Sciences Center

Dear Ms. Jarkowski:

We are in receipt of your project, "The Effects of Thermobiofeedback Therapy in a Cardiac Rehabilitation Program", which was submitted to this Committee for review. The procedures to be followed in this study pose no more than minimal risk to the participating subjects and the device to be used is commercially available. Regulations issued by the U.S. Department of Health and Human Services [45 CFR Part 46.110(b)] authorize approval of this type project through the expedited review procedures, with the condition(s) that subjects' anonymity be maintained. Although full Committee review is not required, a brief summary of the project procedures is submitted to the Committee for their endorsement and/or comment, if any, after administrative approval is granted. This project is approved effective 7 May 1986.

Approval is granted with the understanding that no changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research-related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

Milan Novak

Milan Novak, M.D., Ph.D.
Chairman
Human Subjects Committee

MN/jm

cc: Ada Sue Hinshaw, R.N., Ph.D.
College Review Committee

# APPENDIX B

## SUBJECT CONSENT FORM

# SUBJECT'S CONSENT

## The Effects of Thermal Biofeedback Therapy In A Cardiac Rehabilitation Program

The purpose of this study is to determine the effects of a temperature biofeedback program on patients in cardiac rehabilitation. Participants in the study will have a temperature measurng device taped to the end of a finger then be taught relaxation techniques to raise finger temperature. Raising finger temperature has been shown to dilate blood vessels which may lead to a reduced blood pressure, heart rate, and anxiety level. It may also effect how often angina occurs. Participants in the study must be non-diabetic, active in the rehabilitation program and have a diagnosis of coronary artery disease. In addition participants are to be non-smokers, without previous experience in thermal biofeedback and do not use certain medications which may influence the results of this study. This will be determined on an individual basis.

If you choose to participate, you will be asked to complete a self evaluation questionnaire and a daily flow chart on your heart rate and frequency of angina attacks. You may choose not to answer some or all of the items on the questionnaire. Volunteers will be divided into two groups. Both groups will be responsible for completing the questionnaire at the beginning and the end of the study and for keeping the daily flow charts which will be collected at the end of each week. One group will be required to attend two sessions per week on relaxation and temperature biofeedback for a total of eight session over a four week period. Each session will require less than one hour of your time, often only thirty minutes. Daily home practice for the thermal biofeedback group will be required for all four weeks. This would involve fifteen minutes twice a day. Volunteers will be asked to fast for two hours prior to the sessions just as you do prior to the exercise program (no food or drink except water). The training sessions will be conducted at the university of Arizona, College of Nursing, room #418. There will be no cost for participating in the study.

Side effects known to occur in some individuals from relaxation and biofeedback training are minimal. They are usually the result of a lowered blood pressure, heart rate and/or blood sugar. Vital signs will be monitored and precautions will be taken to prevent any complications in this area. Because of the potential changes in blood sugar, diabetics will be excluded from the study. Benefits you might receive from this study include a decrease in heart rate, blood pressure, anxiety and possibly frequency of angina attacks. you will also be taught relaxation techniques which you may use for the rest of your life.

Participation is completely voluntary and you should feel free to discuss this with your doctor and the nurses at the cardiac rehabilitation center. You may withdraw from the study at any time without incurring ill will and are free to ask questions at any time. You will be given a code number to assure anonymity and confidentiality. Only the primary investigator will have access to your identificatioon by code number. All information will be kept confidential and reported using the code number. Data may be used for future publication.

# APPENDIX C

## ANGINA FLOW CHART

# ANGINA FLOW CHART

Please complete the following information as correctly as possible. Flow Charts will be collected once a week. Thank you.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | | | | | | | |
| Time | | | | | | | |
| Heart Rate | | | | | | | |
| Angina | | | | | | | |
| #NTG | | | | | | | |

Definitions:

**Heart Rate:** Count your heart beat for thirty seconds then multiply times two to get the number of beats per minute. This is to be done after sitting quietly for five minutes and at least two hours after a meal.

**Angina:** Give number of angina attacks you experienced this day. If none, write "none" in this space.

**# of NTG:** Give the number of nitroglycerine tablets taken this day. If none, write "none" in this space. DO NOT include medications you take on a routine basis only those taken "AS NEEDED".

NOTES: Use this area to write down any of your feelings or experiences, side effects or changes in medications prescribed by your doctor. List any particularly stressful events that may have happeded. Give the date and event.

# APPENDIX D

## THERMAL BIOFEEDBACK TRAINING PROGRAM

# THERMAL BIOFEEDBACK TRAINING PROGRAM

I. Meeting #1
   A. Introduction to research project
   B. Volunteer sign up
   C. Appointment made for Meeting #2
II. Initial Screening by Medical Records
   A. Brief medical history
      1. Type of heart disease and when diagnosed
      2. Compliance with selection criteria
      3. List of current medications
      4. Check for angina
         a. Type
         b. Frequency
         c. Frequency of taking medications
   B. Length of time in cardiac rehabilitation program
III. Meeting #2
   A. Assess ability to complete all training sessions
   B. Administer state/trait anxiety test to qualified subjects
   C. Make appointments with experimental group for the thermal biofeedback training
   D. Instructions for angina flow chart to control group
   E. Blood pressure data collection (from medical record)
IV. Experimental group
   A. Session #1
      1. General introduction to thermal biofeedback
      2. Distribute and instruct in use of stress control biofeedback cards
      3. Distribute home practice handouts and angina flow charts
      4. Ten minute acclamation period
      5. Baseline temperature readings
      6. Room temperature readings
      7. Familiarize subjects with equipment and routine
      8. Instructions not to discuss program with control group
   B. Session #2
      1. Baseline readings (includes #'s 4, 5 & 6 above)
      2. Progressive relaxation exercise.
      3. Complete flow sheet for training sessions
      4. Home practice instructions (handouts)
      5. Questions answered
   C. Session #3
      1. Same as #2 except with autogenic exercise
   D. Sessions #4-#8
      1. Same as #2 except with thermal biofeedback
      2. Discuss home practice flow sheet
V. Follow-up
   A. Series of three BP measurements starting three days after last session for both groups
   B. Collect self report on angina
   C. Administration of state anxiety test
   D. Discussion/evaluation of program

# APPENDIX E

## DAILY FLOW CHART FOR THERMAL BIOFEEDBACK TRAINING

# DAILY FLOW CHART FOR THERMAL BIOFEEDBACK TRAINING

Please complete the following information as accurately as possible. You are to complete two relaxation sessions per day. Your training session at the University may count as one session.

<u>Session 1</u>

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | | | | | | | |
| Length | | | | | | | |
| Method | | | | | | | |
| Heart Rate | | | | | | | |
| <u>Session 2</u> | | | | | | | |
| Length | | | | | | | |
| Method | | | | | | | |
| Heart Rate | | | | | | | |
| # of NTG | | | | | | | |
| Angina | | | | | | | |

Definitions:

**Heart Rate:** Count your heart beat for thirty seconds then multiply times two to get the number of beats per minute. Take your heart rate AFTER the relaxation exercises.

**Length:** Length of time doing your relaxation exercixes.

**Method:** Method of relaxation you used. Indicate by putting #1 or #2 from the handouts, or "N" for neither.

**Angina:** Give number of angina attacks you experienced this day. If none, write "none" in this space.

**# of NTG:** Give the number of nitroglycerine tablets taken this day. If none, write "none" in this space. DO NOT include medications you take on a routine basis only those taken "AS NEEDED".

IMPORTANT: Relaxation exercises should be done at least two hours after a meal.

PLEASE BRING THIS RECORD WITH YOU EACH TIME YOU COME FOR THERMAL BIOFEEDBACK THERAPY.

NOTES: Use this area to write down any of your feelings or experiences, side effects or changes in medications prescribed by your doctor. List any particularly stressful events that may have happened. Give the date, the event, and whether relaxation helped. You may use the back side of this paper for your comments.

# APPENDIX F

# HOME PRACTICE HANDOUTS

# INSTRUCTIONS FOR HOME RELAXATION EXERCISES

Choose the method of relaxation you feel most comfortable using. Record this method on your daily flow sheet. Feel free to use more than one method and to vary throughout the week as to which you choose. Practice a minimum of once per day for 15 minutes total time -- twice a day would be ideal. Do before meals or 2 hours after a meal. Your biofeedback session at the hospital may count for one of your home practice sessions.

Precautions:

1. Depersonalization and body sensations may occur. Auditory and visual hallucinations have occurred with some individuals.

2. Deeply repressed thoughts and emotions are sometimes released.

3. This technique may induce an excessively lowered state of psychophysiological functioning: temporary hypotensive state (dizziness, headaches, or momentary fainting, particularly if you stand up immediately; if you feel any light headedness, open eyes and stretch and look around the room); low blood sugar; fatigue in a few individuals.

Remember:

Sit in a reclined position or lay comfortably on a bed or sofa

Make sure your arms and legs are uncrossed

Loosen tight clothing

Remove jewelry/watches

Unplug the telephone - provide for a quiet environment

Use the stress control biofeedback card as instructed

You may keep records of the temperature if you wish

Remember this principle in all your relaxation exercises: Let it happen, don't force it. Relaxation requires no effort. In fact, any effort to relax (by shifting your arm or engaging muscles anywhere) actually causes tension. Stop doing and let relaxation happen. It's when you give up and just let yourself go (which is often a light, floating sensation) that you'll be relaxing yourself most deeply.

During the relaxation session, if your thoughts wander, just bring your concentration back to your breathing. Allow these thoughts to drift through your mind. Don't try to force them out or you will become more tense. Don't try to remember them nor do anything with them. Just allow them to drift through, let your thoughts slow down, let your mind relax (Wentworth and Rohr, 1984).

ADDITIONAL COMMENTS

If you feel tense in any part of your body, tighten that muscle group for a count of five, then relax and let go. Learn to search your body for areas of greatest tension and devote more time to learning to relax them. When you have mastered the relaxation response, you will be able to produce it while driving, at work and eventually during stressful times. It takes practice, pracTICE, PRACTICE.

The constriction of blood vessels due to high adrenalin levels can cause cold hands. If you place your hands on your cheeks and your hands are colder than your cheeks, you are likely to be having an adrenalin surge. You may wish to check the temperature of your fingers with the biofeedback card. Adrenalin surges should not be allowed to continue beyond the immediate situation that stimulated the response. As soon as possible you should bring down the level of arousal and produce a relaxation response for recovery. Without recovery, disease is more likely to occur. When you have produced a relaxed state (warm hands) remain in that state for a period of time. You will benefit more by staying relaxed (warm) than by just becoming warm and then cold again.

To relax your thinking, practice not thinking or thinking slowly. Repeat to yourself "I will not think -- just be," or "I ... am ... not ... going ... to ... think ... rapidly."

Here are some new habits for you to practice:

"speak more slowly and deliberately
pause regularly between phrases
learn to be a better listener
walk more slowly
don't do more than one thing at a time
eat more slowly and savor your food
drive more slowly
do nothing for thirty minutes -- EVERY day

If we slow down these behaviors, we can slow down our metabolism, reduce our need for adrenalin, and preserve the wonderful temple of the body that God has given us for our enjoyment." (Hart, 1986, p. 187).

# PROGRESSIVE RELAXATION
(Method #1)

This is an exercise in progressive relaxation. Please follow the instructions as they are given. Some people have reported feelings of floating, numbness or tingling sensations during the exercise so do not be alarmed if this should happen to you. We will now begin.

Take a deep breath. Inhale slowly. As you exhale, gradudually let your eyes close. Take four more deep breaths, inhaling and exhaling slowly, keeping your eyes closed. Think of your body as being very relaxed.

Curl your toes down toward the floor. As you do so, be aware of the tension that is created in your toes and in the arches of your feet. Study that tension. And now relax. Allow the feet to go limp. Note the difference between the tension you felt earlier and the relaxation you feel now.

Point your toes toward your head. Feel the tension in your calves and in your shins. Study that tension. Study it, and now let go. Allow the muscles to loosen. Relax.

Now stretch both legs. Stretch them way out. As you hold that stretch, be aware of the tension in your legs. Feel that tension. And now relax. Allow the tension to leave your body. Let go.

Press the heels of your feet down as hard as you can, tightening the thighs. Concentrate on that tightness. Now relax. Let go. Note the difference between the tension you felt earlier, and the warm sense of relaxation you feel now.

Tighten your buttocks. Tighten it and hold it. And now let go. Try to sense the body becoming loose. A sense of heaviness should be present throughout the body. Relax.

Now tighten your stomach muscles. Make the stomach very hard. And now let go. Relax the stomach muscles and let the body become loose, and more and more relaxed.

Take a deep breath. Fill your lungs with air and hold it. Hold it, and study the tension throughout your chest and down into your stomach. And now exhale. Continue breathing comfortably and quietly, and sense the difference in tension levels.

Arch your back. Arch it, pushing out your chest and stomach so that you feel the tension in your upper back. And now let go. Relax those muscles. Let them be loose and relaxed.

Now shrug your shoulders. Bring both shoulders up towards your ears. Study the tension in your shoulders and in your neck. And now relax. Go limp. Noting once again the difference between the tension and the relaxation.

Clench both your fists. Slowly bend the forearm at the elbow and bring them to your shoulders so as to tighten the biceps muscle. Feel the tension in the upper arms. And now relax. Drop your arms back down to your sides and notice the feeling of relaxation now in your arms.

Make a tight fist with both hands. Stiffen your arms, and press down hard with the straightened arms. Feel the tension. Study the tension. Now relax. Let the arms go limp.

Now bend both hands back at the wrists, fingers pointing toward the ceiling. Concentrate on the tension in the back of the hand and in the forearm. Study the tension, and now relax. Let the hands return to their resting positions. Go limp.

Clench both fists together. Clench them tightly. Feel the tension. And now relax. Let go. Let your fingers spread out and feel the warmth of relaxation.

Press your head backwards and hold it. Hold it, and feel the tension that is created in the back of the neck. Now relax. Allow that tension to leave your body. Let go.

Bend your head forward, pressing the chin to the chest. And now relax. Return your head to the resting position, and note the difference between the tension and the relaxation.

Now clench your jaw. Bite down tightly. Now show your teeth in a forced smile. Hold it, and now let go. Relax.

Now open your mouth widely. As widely as you can. And now relax. Let the muscles go loose.

Now purse your lips. Press them tightly together and feel the tension all around the mouth. And now relax. Let go of the muscles more and more, further and further.

Now lift your eyebrows, wrinkling up your forehead. Wrinkle your forehead as much as you possibly can, and then let go. Smooth out the forehead. Relax.

Close your eyelids tightly and wrinkle your nose. Feel the tension. Feel it, and then let go. Relax those muscles.

Inhale and exhale as deeply as you can three times. As you return to normal breathing, slowly and gradually open up your eyes, and enjoy the feeling of relaxation.

# AUTOGENIC RELAXATION SCRIPT
## (Method #2)

Directions: The purpose of autogenic relaxation is to use your thoughts to produce a relaxed state throughout your body. Either sit in a reclined position or lay comfortably on a bed or sofa. Make sure your arms and legs are uncrossed. Remove any jewelry and loosen tight clothing. With practice you will be able to say the following script to yourself with your eyes closed. If you wear contact lenses or glasses it is best to remove them.

It is best to do the session alone, in a place where you will not be disturbed. Allow 15-20 minutes for the entire session. You may wish to unplub the telephone if one is nearby. You should wait at least two hours after a meal before beginning the relaxation session.

1. I feel quite quiet.
2. I am beginning to feel quite relaxed.
3. My feet feel heavy and relaxed.
4. My ankles, my knees and my hips feel heavy, relaxed and comfortable.
5. My solar plexus, and the whole central portion of my body, feel relaxed and quiet.
6. My hands, my arms and my shoulders feel heavy, relaxed and comfortable.
7. My neck, my jaws and my forehead feel relaxed. They feel comfortable and smooth.
8. My whole body feels quiet, heavy, comfortable and relaxed.
9. Continue alone for a minute. Imagry suggestions.
10. I am quite relaxed.
11. My arms and hands are heavy and warm.
12. I feel quite quiet.
13. My whole body is relaxed and my hands are warm, relaxed and warm.
14. My hands are warm.
15. Warmth is flowing into my hands. They are warm ... warm.
16. I can feel the warmth flowing down my arms into my hands.
17. My hands are warm, relaxed and warm.
18. Continue alone for a minute.
19. My whole body feels quiet, comfortable and relaxed.
20. My mind is quiet.
21. I withdraw my thoughts from the surroundings and I feel serene and still.
22. My thoughts are turned inward and I am at ease.
23. Deep within my mind I can visualize and experience myself as relaxed, comfortable and still.
24. I am alert, but in an easy, quiet, inward-turned way.
25. My mind is calm and quiet.
26. I feel an inward quietness.
27. Continue alone for a minute.
28. The relaxation and reverie is now concluded and the whole body is reactivated with a deep breath and the following phrases: "I feel life and energy flowing through my legs, hips, solar plexus, chest, arms and hands, neck and head ... The energy makes me feel light and alive." Stretch.

(Ref: Green and Green, 1983).

# INFORMATION SHEET

Highly stressful life-styles have been known to contribute to heart disease. Stress results from anything that threatens, excites, scares, worries, annoys, angers, challenges or criticizes you, to name a few. So, good things as well as bad things may be stressful. Too much stress results in chronically high adrenalin levels in our blood which in the long run is harmful to us. Excess levels of cirdulating adrenalin may:

1. increase muscle tension
2. elevate blood pressure
3. increase blood cholesterol
4. increase plaque formation in the arteries
5. increase tendency for blood clots
6. stimulate headache
7. stimulate ulcers
8. increase anxiety
9. cause some forms of cancer
10. interfere with one's ability to sleep
11. create poor eating habits
12. cause us to age faster
13. hinder the body's immune system (causing disease)
14. lead to increased use of alcohol, cigarettes or other drugs and
15. deplete the body of endorphins which naturally help the body to ease pain.

Pain can at first be hidden by high levels of adrenalin so that people will not show signs of disease until the illness is very far advanced. Rest, however, increases the production of these endorphins. Thus, every highly stressful peak in our lives should be followed by a valley of rest and recuperation to avoid stress damage to our bodies. We must balance our periods of stress with periods of relaxation.

It is possible to be an adrenalin addict. You may be able to tell if you are an adrenalin addict if you experience these things especially when trying to relax or take a vacation:

1. "a strong compulsion to be 'doing something' while at home or vacation
2. an obsession with thoughts about 'what was left undone'
3. a feeling of vague guilt while resting
4. fidgetiness, restlessness, pacing, leg kicking, or fast gum chewing
5. an inability to concentrate for very long on any relaxing activity
6. feelings of irritability and aggravation
7. a vague (or sometimes profound) feeling of depression whenever you stop activity."

(REF: Dr. Archibald D. Hart. <u>Adrenalin & Stress</u>. Word books: Waco, Texas, 1986., p. 89).

"We can decide either that we need the adrenalin and therefore can let it do its work or we can decide that we need to conserve our energy and therefore slow down the adrenalin response." (Hart, p. 115).

**YOU CAN LEARN TO MASTER YOUR ADRENALIN RESPONSE**

# APPENDIX G

## FLOW CHART FOR THERMAL BIOFEEDBACK TRAINING SESSIONS

FLOW CHART FOR THERMAL BIOFEEDBACK TRAINING SESSIONS

| | | | | |
|---|---|---|---|---|
| Date | | | | |
| Time | | | | |
| Session # | | | | |
| HR Before | | | | |
| HR After | | | | |
| BP Before | | | | |
| BP After | | | | |
| Temp. Int. | | | | |
| Max. | | | | |
| End | | | | |
| Time of last meal | | | | |
| Notes | | | | |
| Room Temp. | | | | |
| Oral Temp. | | | | |

============================================================

| | | | | |
|---|---|---|---|---|
| Date | | | | |
| Time | | | | |
| Session # | | | | |
| HR Before | | | | |
| HR After | | | | |
| BP Before | | | | |
| BP After | | | | |
| Temp. Int. | | | | |
| Max. | | | | |
| End | | | | |
| Time of last meal | | | | |
| Notes | | | | |
| Room Temp. | | | | |
| Oral Temp. | | | | |

# APPENDIX H

## SUBJECTS EVALUATION OF THERMAL BIOFEEDBACK PROGRAM

EVALUATION OF THERMAL BIOFEEDBACK PROGRAM

1. Would you like to continue with the thermal biofeedback (TBF) program?

2. Do you plan on practicing the relaxation techniques after the study is complete?

3. Would you like to see thermal biofeedback become part of your cardiac rehabilitation program?

4. Have you noticed any benefit from the TBF program? Please explain.

5. What changes would youmake in the program?

Other comments:

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