REDUCING HEART RATE AND DIASTOLIC AND SYSTOLIC BLOOD PRESSURE USING NONPHARMACOLOGICAL METHODS IN THE TREATMENT OF ESSENTIAL HYPERTENSION

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by

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Abstract

Hypertension affects 20% of our population and can lead to heart and kidney failure, stroke, and blindness. Heightened sympathetic nervous system activity may be responsible for this disease in young patients. Eight subjects (medicated and unmedicated), 45 years of age or younger, diagnosed with essential hypertension were placed into one of two groups, one receiving four weeks of hypnosis training followed by four weeks of thermal biofeedback, or a group receiving four weeks of thermal biofeedback followed by four weeks of hypnosis training. Heart rate, diastolic and systolic blood pressures were recorded for each subject during every session of four study phases (baseline, treatment 1, treatment 2, and posttreatment). The goal of this study was to lower heart rate, diastolic and systolic blood pressures in essential hypertensive patients, aged 45 years of age or younger, by reducing peripheral sympathetic nervous system activity through the use of hypnosis and thermal biofeedback, thereby facilitating vasodilation in the periphery. Since both of these treatment strategies concentrated on the same physiological process, an examination of the effectiveness of the two interventions was performed. Both treatment modalities were found to be equally effective in significantly reducing diastolic and systolic blood pressures, however heart rate was found to increase significantly during a brief posttreatment period. The results suggest that blood pressure can be controlled using noninvasive treatment procedures alone or as an adjunct to pharmacological therapies.

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This paper is dedicated to Kristin, my wife, who not only sacrificed so much during its completion, but who is also responsible for a great deal of my academic success.

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Introduction

Research has suggested that a significant impact on public health can be obtained through changes in behaviour (Kaufmann, Chesney, & Weiss, 1991). Strokes and heart attacks often occur during periods of high emotion, and numerous behavioral studies have indicated that hypertensive subjects reveal greater blood pressure, heart rate, and/or catecholamine responses than normotensives to various frustrating and stressful tasks and activities. However, behavioralists have been unable to successfully identify a specific stressor linked to the etiology of essential hypertension that is reactive for all patients. Stress, in the generic sense, is believed to elevate blood pressure in many mild/borderline hypertensives by stimulating an increase in peripheral sympathetic nervous system activity, thus releasing the catecholamine, norepinephrine, which causes blood vessels in the periphery to constrict. Therefore, reducing sympathetic activity should cause normalization of blood pressure. Drug therapies have been effective in achieving this goal, but most agents that lower blood pressure are capable of causing an individual distressing symptoms from such side effects as postural hypotension, impotence, or fatigue. The efficacy of behavioral treatments for hypertension has been largely equivocal, perhaps primarily because they have lacked specificity for the physiology of blood pressure regulation they attempted to correct. It is the purpose of this study to lower diastolic and systolic blood pressure and heart rate in medicated and unmedicated essential hypertensive patients, 45 years of age or younger, by reducing peripheral sympathetic nervous system activity through the use of hypnosis and thermal biofeedback, thereby facilitating vasodilation in the periphery. Since both of these treatment strategies are concentrating on the same physiological process (promoting vasodilation in the periphery), a comparison of their effectiveness will be conducted. To obtain a greater understanding of this disorder and the reasons for using behavioral interventions to combat hypertension, it is important to provide a better definition of this malady, the present pharmacotherapeutic strategies and their side-effects, the relationship between hypertension and the sympathetic nervous system, and the use of thermal biofeedback and hypnosis as effective nonpharmacological treatment modalities.

Hypertension is a serious disorder which is a major risk factor for coronary artery disease and a common antecedent of heart failure, kidney failure, stroke, and blindness (Smith & Kampine, 1984), therefore it can reduce the life expectancy of an individual afflicted with this disease (Tursky, Papillo, & Friedman, 1982). Approximately 20% of the adults in this country are afflicted with hypertension (Smith & Kampine, 1984), which affects over 10% of the world's adult population

(Levine & Fodor, 1990). It has been dubbed "the silent killer," because very little symptomatology is present until pathognomonic damage has occurred, usually in the form of the aforementioned disease states (Levine & Fodor, 1990). This disease is better known to the layperson as high blood pressure.

Blood pressure enables the blood to be circulated throughout the body via the blood vessels, with the pressure in the system being produced by cardiac output. Blood pressure is required in order to ensure that all organs receive essential oxygen and nutrient rich blood for proper functioning. Due to changes in cardiac output and/or vascular resistance to blood flow, an individual's blood pressure can be elevated or lowered (Smith & Kampine, 1984). Blood pressure can also vary throughout the course of the day, dependent upon one's involvement in various activities. For example, it will be increased during exercise, mental stress, and sexual intercourse, and decreased during sleep (Levine & Fodor, 1990). However in some individuals this elevation in blood pressure remains high, even when the body does not need such an increased level. This sustained elevation in blood pressure is termed hypertension. In approximately 95% of all cases of hypertension, the etiology of this disorder is unknown, and is termed essential or primary hypertension (Levine & Fodor, 1990). It is generally believed that environmental, endocrine, neurological, hemodynamic, and psychosocial variables interact as antecedents of essential hypertension (Olson & Kroon, 1987). The other 5% of hypertension cases are labelled as secondary hypertension and arise from a specific disease or pathological abnormality in the body (Olson & Kroon, 1987). A diagnosis of hypertension, however, is not a sentence for future health deterioration. Research has documented that individuals who have their hypertension detected and treated, tend to live healthy lives (Sackett, 1990).

Pharmacological Treatment

Pharmacological treatments have been the most widely used therapy for hypertension and have clinical efficacy with regard to longevity and reduced morbidity for those mildly hypertensive patients prescribed a pharmacological regimen (Wadden, Luborsky, Greer, & Curtis-Cristoph, 1984). The Veterans Administration Cooperative Study Group (cited in Jacob, Wing, & Shapiro, 1987) reported that in patients with moderate to severe hypertension, reducing blood pressure with pharmacotherapy therapy resulted in substantial health benefits, including prevention of cerebrovascular events and heart failure. Drug therapy enables a patient's blood pressure to decrease by acting on those mechanisms that regulate blood pressure (Myers, 1990). Pharmacological treatments, however, are not a panacea for this disorder, and all agents that lower blood pressure are capable of causing the patient distressing symptoms (Mann, 1986).

Diuretics are used to reduce the amount of water and sodium in the body, therefore promoting vasodilation and reducing blood pressure. Treatment with diuretics can lead to chemical side effects such as increases in blood sugar, uric acid, and blood cholesterol, and a decrease in blood potassium. Diuretics can also promote postural hypotension, impotence, and dehydration (Carruthers and Dean, 1990). Drugs that work on the sympathetic nervous system (i.e., Alpha and Beta-blockers) have been reported to cause fatigue, depression, sexual dysfunction, headaches, and postural hypotension (Onrot, Wilson, & Dubois, 1990). Angiotensin-converting-enzyme inhibitors (commonly called ACE inhibitors) are used to reduce the production of angiotensin II, a powerful hormone which constricts the vasculature. ACE inhibitors may decrease kidney function, cause potassium accumulation, skin rashes, taste disturbances, reduction of leucocytes, and angioedema (Roy and Leenen, 1990a). Calcium within the walls of the vasculature can promote vasoconstriction, thereby increasing resistance to blood flow and elevating blood pressure. Calcium antagonists work to reduce the entry of calcium into the cells of the blood vessel walls and enhance vasodilation. However, side effects associated with the use of these agents are headaches, palpitations, flushing, ankle swelling, nausea, heartburn, and constipation (Roy and Leenen, 1990b). Vasodilators are the final class of antihypertensive medications, and they decrease vascular resistance by relaxing the muscle of the blood vessel walls. This form of treatment may promote factors that actually work against the blood pressure regulating mechanisms, such as causing the kidneys to retain water and sodium and increasing cardiac output. Other side effects are headache, flushing, palpitations, ankle swelling, and in high doses may cause the patient to produce antibodies against his own body, resulting in painful, swollen joints (Roy and Leenen, 1990c).

Due to the negative side effects, both somatic and psychological, coupled with the cost of this lifelong treatment regimen, it is easy to understand why patient compliance with antihypertensive medications can be as low as 25%-30% (Wadden et al., 1984; & Olson & Kroon, 1987). Since many hypertensive patients are asymptomatic, it is felt that the given therapy should be largely without side effects, since numerous risk factors for hypertension are approachable through nonpharmacological strategies (Kaplan, Brenner, & Laragh, 1989). Risk factors that are most often examined in the etiology of essential hypertension are age, sex, hereditary and racial predispositions, obesity, smoking, dietary factors, level of physical activity, stress, sociocultural variables, and personality variables (Olson & Kroon, 1987). Since nonpharmacological therapies are not drug induced, it would be expected that they would reduce the side effects of drug treatment and be more effective in battling the psychophysiological aspects of hypertension. It is the risk factor of stress, with its relationship to the etiology and maintenance of essential hypertension, and the application of nonpharmacological methods to reduce its physiological effects on the patient that are the focus of this paper.

Role of Stress

Evidence is presented in a review by Henry (1988), that in both animals and man, psychosocial stress will trigger high blood pressure despite severe reduction of salt intake. However, populations with high salt consumption (believed to be a link to hypertension) will escape the disease, and its accompanying increase of blood pressure with age, if there is little psychosocial stress. The lack of importance accorded by the medical community to psychological factors of hypertension stands out, since clinicians have observed over time that strokes and heart attacks often occur during periods of heightened emotion (Mann, 1986). Numerous studies have recently demonstrated that hypertensive subjects reveal greater blood pressure, heart rate, and/or catecholamine responses than normotensives (individuals presenting with blood pressure < 140/90 mmHg) to frustrating cognitive tasks, stressful interviews, video games, and occasionally the cold pressor test (Julius & Bassett, 1987). Henry (1988) also reports that blood pressure rises when there is a money economy as opposed to the traditional society of rule by ritual and taboo. This may further support the need for a stress coping therapy in the industrialized (money economy) lifestyle of the civilized world. While stress can be applied to the circumstances or stimuli that an individual reacts to, there is no specific type of stressor which enables a pressor response for all subjects, although for any individual, some stress can cause blood pressure to rise (Mann, 1986).

When stress is thought of as a risk factor for essential hypertension, it is due to the physiological effects on an individual's body from this psychological element. Goldstein (1981) provides several examples of stressful stimuli, such as orthostasis, isotonic and isometric exercise, exposure to cold, hypoglycemia, hypoxia, pain, and environmental situations eliciting emotional responses such as anxiety or anger. It is the autonomic nervous system which exerts a great influence on blood pressure control, and in particular it is a division of this system, the sympathetic nervous system, that is responsible for elevating blood pressure during stress. The sympathetic nervous system produces the fight-or-flight response, which prepares an individual for survival during threatening situations and produces the kind of bodily changes an individual experiences after a sudden fright or when they are feeling tense (e.g., increased heart rate). When activated, the system sends sympathetic nerve impulses down its nerve pathways through the spinal cord and travels out to receptor sites on the blood vessels, sweat glands, muscle fibres in the skin, and organs in the head, neck, thorax, abdomen and pelvis (Beaumont, 1988). The sympathetic nerves release the neurohormone, norepinephrine, which appears in the blood and attaches itself at receptor sites on the aforementioned tissues (Kopin, McCarty, & Yamaguchi, 1980). Norepinephrine has two types of receptors, known as alpha and beta. The blood vessels have alpha receptors, which when activated cause the blood vessels to constrict, thereby increasing resistance and raising blood pressure. When beta-1 receptors, located in the heart, are stimulated they elevate blood pressure by increasing heart rate (Onrot et al., 1990).

While individuals react differently to stressful stimuli, the progression of events that induce elevations in heart rate, cardiac output, and blood pressure involves activation of the central nervous system, increased sympathetic nerve activity, and release of norepinephrine at the sympathetic nerve endings. The norepinephrine that is released causes the changes in heart rate and blood pressure and increases the level of the catecholamine found in the plasma (Kopin et al, 1980). In a review of studies measuring norepinephrine levels between normotensives and hypertensives during exposure to various stressful stimuli, Goldstein (1981) found that hypertensives displayed higher levels of the catecholamine at rest and during exercise. It was further reported that the differences in sympathetic activity between the two groups was dependent upon the intensity of the stress.

It has been shown that hypertensive individuals tend to demonstrate greater blood pressure reactivity to norepinephrine than normotensives (Pickering & Gerin, 1990), and that indices of sympathetic nervous system activity (e.g., heart rate and systolic and diastolic blood pressure) are more hyperreactive to stressful stimulus in hypertensives (Drummond, 1983; Menkes et al., 1989). Increased cardiovascular sympathetic nervous system activity (i.e., systolic and diastolic blood pressure and heart rate) in response to a vigilance task (a reaction-time task coupled with a noxious stimuli which was presented depending upon subject performance), illustrated that greater cardiovascular reactivity existed in hypertensives (both established and labile hypertension) compared to normotensives (Fredrikson & Engel, 1985). Drummond (1983) has also examined cardiovascular hyperreactivity differences between normotensives and labile hypertensives and found that cardiovascular responses were larger in hypertensives during psychological stress (i.e., mental arithmetic). An extensive review on the variation between hypertensives and normotensives with regard to their cardiovascular responses to behavioral stress was undertaken by Fredrikson and Matthews (1990). Three major conclusions were the basis of their meta-analysis. They noted that essential hypertensives exhibited exaggerated blood pressure responses to all stressors, active (e.g., mental arithmetic), passive (e.g., watching a stressful film), and the cold pressor test. Secondly, that individuals presenting with labile hypertension displayed exaggerated systolic and diastolic blood pressure and heart rate responses to active psychological stressors. Finally, that normotensive offspring of hypertensive parents showed elevated systolic blood pressure and heart rate responses to all stressors and elevated diastolic blood pressure responses to active stressors. The major finding of these cardiovascular hyperreactivity studies (Drummond, 1983; Fredrickson & Engel, 1985; Fredrickson & Matthews 1990; Menkes et al., 1989) is that excessive sympathetic nervous system activity, initiated through the presence of stressful stimuli, can have a pathophysiologic role in essential hypertension. Therefore, it should be expected that those patients who are discovered to have demonstrable sympathetic involvement in their hypertension will be those who benefit the most significantly from sympathetically-mediated stress treatment modalities.

There have been numerous studies that have compared the levels of norepinephrine between patients with essential hypertension and normotensives. Goldstein (1983) has reviewed the statistical results of 64 studies and found that in 81% of these analyses hypertensives demonstrated higher levels of norepinephrine than normotensives. Since plasma norepinephrine increases with age in normotensives, but not in hypertensives, in those studies where the mean age of both groups was 40 years or younger, hypertensives almost always demonstrated higher levels of plasma norepinephrine. Where the mean age was greater than 40 years, the differences between the two groups was smaller and less consistent due to the age-related increase in norepinephrine in the normotensives. A further study (Goldstein et al., 1983) was undertaken to advance the age-related norepinephrine findings of the previous investigation. In a comparison of outpatient and inpatient normotensive and hypertensive patients, plasma norepinephrine levels were slightly but significantly higher in those with a diagnosis of essential hypertension. When the patients were younger than 40 years old, the hypertensive-normotensive difference in plasma norepinephrine was highly significant. The results of this study, coupled with the findings of the aforementioned analytical review (Goldstein, 1983), clearly display an age-dependence factor associated with the presence of plasma norepinephrine in younger hypertensive patients compared to their normotensive counterparts. However, in a study in which labile hypertensives (blood pressure readings in the range of 160/95 - 140/90 mmHg), mild hypertensives (diastolic blood pressure measured consistently between 90 and 105 mmHg), and normotensives were tested at 30% of their maximal strength during a hand grip task, it was found that resting norepinephrine levels were higher in the two hypertensive groups, but that the age of the subjects was not a factor (de Champlain, Petrovich, Gonzalez, Lebeau, Nadeau, 1991). It must be noted that the mean age of all of the groups was below 50 yrs.(mild hypertensives 47.5 yrs., labile hypertensives 37.1 yrs., and normotensives 36.5 yrs.), which demonstrated that excessive sympathetic activity can be present in hypertensive patients older than 40 yrs. of age. They also reported that the elevation in blood pressure in the two hypertensive groups during the isometric exercise was attributable to an increase in peripheral resistance, while the hemodynamic mechanisms in the normotensives centred around an increase in cardiac contractility and performance. This demonstrated an enhanced alpha-adrenergic vascular reactivity in these hypertensive patients, regardless of age.

Another measure of sympathetic activity in hypertensive patients is achieved through changes in sympathetic nerve activity. Directly recording sympathetic nerve activity reduces the criticism of studies using elevated plasma norepinephrine levels as a marker of sympathetic nervous system activity (which may reflect neuronal outflow, augmented transmitter release, and/or impaired reuptake) (Anderson, Sinkey, Lawton, & Mark, 1989). In a study by Yamada, Miya Jima, Tochikubo, Matsukawa, and Ishii (1989), they examined age-related changes between normotensive and essential hypertensive patients of the muscle sympathetic nerve activity of the tibial nerve. Patients were divided into three age groups, young (≤ 30 yrs.), middle age (31-50 yrs.), and old (≥ 51 yrs.). Muscle sympathetic nerve activity was recorded by microneurography and evaluated by burst rate (bursts/min.), burst incidence (bursts/100 heart beats), and spike frequency (spike/min.), while the patients were resting. These researchers found that muscle sympathetic nerve activity was elevated in hypertensive patients compared to their age-matched normotensive subjects, and that this activity was significantly correlated with age in both types of subjects. Based upon their results, they concluded that an increase in sympathetic nerve activity is a significant factor in the maintenance of high blood pressure. These studies of plasma norepinephrine (de Champlain et al., 1991; Goldstein, 1983; Goldstein et al, 1983) and muscle sympathetic nerve activity (Yamada et al, 1989) provide evidence of an overactive sympathetic nervous system in the maintenance of essential hypertension that is more pronounced in patients less than 50 yrs. of age, and appears to enhance alpha-adrenergic reactivity. Therefore, reducing peripheral vasoconstriction in these individuals should block or lower the effects of sympathetic nervous system overactivity and cause a subsequent lowering of blood pressure. Many drugs which are effective in lowering blood pressure in patients with essential hypertension work by partially or completely blocking the release of norepinephrine from sympathetic nerve endings (Kopin et al., 1980), however as discussed above, there are negative side effects that can be associated with these agents. Nonpharmacological treatment strategies should remove the vexatious side effects of drug interventions, and prove to be effective in treating the psychophysiological indices of stress on the sympathetic nervous system.

Biofeedback Treatment

While there have been numerous behavioral strategies attempted in the fight against essential hypertension, especially the use of progressive muscle relaxation, the most promising results have occurred with the use of thermal biofeedback. This technique provides the patient with an indirect measure of peripheral vasodilation. Since blood vessels in the periphery are, for practical purposes, inaccessible, measuring the individual's surface temperature can provide an evaluation of increased blood supply (vasodilation) or decreased blood supply (vasoconstriction). This is due to the fact that during vasoconstriction, blood vessels transfer less warm blood than during vasodilation, causing the surrounding tissue to warm or cool as vascular diameter changes. The extremities (usually the fingers and toes for this treatment modality) generally provide the most pronounced changes in vascular diameter and also the location where the small amount of surrounding tissue provides temperature fluctuations quickly in response to changes in the blood supply (Schwartz, 1987). Patients are taught how to engage in peripheral vasodilation by warming their hands and then their feet using suggestions of warmth, heaviness, and relaxation, while receiving auditory or visual feedback of their temperature changes. Therefore, finger temperature is used as an index of stress, with vasoconstriction of the fingers or toes associated with sympathetic arousal resulting in a reduction in skin temperature (Blumenthal, 1985).

While the use of relaxation techniques tended to be at the forefront of behavioral interventions, thermal biofeedback has been found to be a more effective treatment modality. A study by Blanchard et al. (1984), compared the use of thermal biofeedback and relaxation in a study of hypertensives who were prescribed two or more drugs to control their blood pressure. Each patient went through either eight weeks of relaxation or eight weeks of thermal biofeedback concentrating on hand warming, followed by a three month post-treatment period where each patient was removed from their second-stage drug. Analysis at the end of the post-treatment phase demonstrated that thermal biofeedback was significantly more effective than the relaxation, both in the laboratory setting and during home blood pressure readings.

These identical treatments were examined again by Blanchard et al. (1986), for effectiveness, superiority, and with a greater number of subjects. Eighty-seven hypertensive patients who had their blood pressure controlled on at least two pharmacological agents were selected for participation in this study. Patients were withdrawn from their second stage medication prior to treatment or following the treatment phase. They underwent 16 sessions of biofeedback concentrating on increasing hand temperature or 8 sessions of progressive muscle relaxation. The confound of the variability in the number of treatment sessions between the two groups was deliberate and based on the number of sessions believed necessary for an appropriate trial of the specific treatment. Short term efficacy of one to two months after treatment between the two modalities favoured thermal biofeedback, where these patients were able to remain off of their second stage medication almost three to one compared with those individuals in the relaxation group. At one year follow-up, the long term effectiveness remained superior for the biofeedback group over relaxation, with a ratio of over two to one remaining off their second stage medication. In fact, the long term success rate for the thermal biofeedback patients falling into this category was 50%, and 37.5% for those relaxation patients meeting the criteria.

Further success has been achieved in reducing medication requirements and blood pressure in hypertensive patients using thermal biofeedback. In a study examining 77 medicated and unmedicated patients, the effects of thermal biofeedback were analyzed with an average follow-up period of 33 months (Fahrion, Norris, Green, Green, & Snarr, 1986). Both hand and foot warming were included in the biofeedback protocol of this study. Patients were categorized as achieving either "Complete Success" (returning to an average blood pressure of 140/90 mmHg or less, in the absence of medication), "Partial Success" (bringing blood pressure down to 140/90 mmHg or less while on a reduced level of medication or remaining on the original dosage, or for those unmedicated patients a reduced systolic or diastolic blood pressure without reaching the targeted level of 140/90 mmHg), or "Failure" (no reduction in blood pressure or level of medication). At the end of the treatment protocol it was found that 58% of the medicated patients completely eliminated their antihypertensive medication while reducing their blood pressure, 35% were classified as "partial success" cases and 7% fell in the "failure" category. In the unmedicated patients the achievement rate was even more pronounced, with 70% achieving blood pressures below the criterion level, 22% classified as "partial successes" and 8% as "failures." These results are made even more impressive by the fact that after an average of 33 months of follow-up data, the total patient sample contained only an 8% "failure" level, while 92% of the sample maintained some level of reduction in blood pressure and/or medication. This study further demonstrates the usefulness of thermal biofeedback as both an alternative and an adjunct to pharmacological approaches in the treatment of essential hypertension, providing a noninvasive and side-effect free technique.

Another evaluation of lowered sympathetic nervous system activity using thermal biofeedback has been demonstrated while measuring plasma norepinephrine in medicated hypertensive patients (McCoy et al., 1988). Thirty patients received 16 sessions of thermal biofeedback and 22 received 8 sessions of progressive muscle relaxation. Venous plasma norepinephrine samples were removed from the left arm and taken prior to treatment and within three weeks following treatment. The thermal biofeedback treatment group achieved significant reductions in mean arterial pressure and plasma norepinephrine, which supports the hypothesis that this technique functions by reducing peripheral sympathetic tone.

No significant changes in blood pressure or norepinephrine levels were recorded in the patients receiving progressive muscle relaxation. Not only does this study once again show the superiority of thermal biofeedback as a behavioral treatment modality compared to progressive muscle relaxation, but it also supports its ability to change a physiological response, that being peripheral sympathetic tone.

Thermal biofeedback has also demonstrated its psychophysiological effectiveness in the treatment of Raynaud's disease (Freedman, Ianni, & Wenig, 1983; Freedman, 1987; Rose & Carlson, 1987; Stambrook, Hamel, & Carter, 1988). Raynaud's disease is a disorder of the peripheral vasculature that occurs with painful episodes of vasoconstriction in the fingers and toes, and is precipitated by cold and/or emotional stress (Freedman et al., 1983). It is believed that sympathetic hyperactivity in the periphery may cause this vasoconstrictive disorder (Freedman, 1987), which can be controlled by thermal biofeedback with resultant vasodilation and reduction of the occurrence of the vasospasms. The use of biofeedback in the treatment of Raynaud's disease is presented here because of its similarity in attempting to achieve the same underlying physiological response (reduced peripheral sympathetic nervous system activity) as in the treatment of essential hypertension. Raynaud's patients exposed to thermal biofeedback have had a reduction in reported symptom frequency for up to three years and were able to voluntarily increase finger temperature up to one-year posttreatment (Freedman, 1987). This encourages the use of thermal biofeedback in the treatment of essential hypertension, in view of the fact that the psychophysiological effects of this therapy have been favourably demonstrated in the treatment of Raynaud's patients. These patients have shown that by reducing peripheral sympathetic tone through a noninvasive behavioral strategy, a stress-induced disorder can be overcome without suffering from vexatious side-effects.

Hypnosis Treatment

While thermal biofeedback has been shown to be effective in the treatment of essential hypertension, and superior to relaxation therapy, another modality that can have an effect on peripheral vasodilation (but has received little attention in the hypertension literature) is hypnosis. Individual control of skin temperature has been studied in normotensive populations with successful results (Barabasz & McGeorge, 1978; Roberts, Kewman, & MacDonald, 1973). In a study designed to demonstrate that peripheral vasodilation can be induced by cognitive control (Roberts et al., 1973), six highly hypnotizable subjects each underwent three sessions, consisting of a 10 minute individual hypnotic induction procedure followed by 24 minutes of auditory hand temperature biofeedback per session. While the subject was under a hypnotic trance, the objective was to raise or lower a presented auditory tone, based on whether the subject was attempting to increase the surface temperature of their left or right hand. Two of the subjects also completed two extra experimental sessions, in which they went through the same procedures as above, without the presentation of the auditory feedback. Five of the six subjects were able to significantly increase peripheral temperature during some stage of the experimental procedure, while only one subject was unable to produce a variation between hands. The two subjects that underwent the extra two sessions were able to increase their hand temperature differential in the absence of auditory feedback, performing better than in the previous trials. This study displays the voluntary control that individuals can have over the regulation of physiological processes involved in the management of thermal changes in the periphery. While the independent variables of hypnosis and auditory biofeedback are confounded in this study, it must be remembered that those subjects who completed the two extra sessions without biofeedback displayed a significantly greater ability to produce hand temperature changes. Although this does not completely remove the confound, it does provide some support for the positive effects of hypnosis on peripheral vasodilation. Two separatc experimental groups, one using biofeedback and one using hypnotic procedures for producing vasodilation, would remove this confound.

Examining the effects of hypnosis versus other modalities in producing peripheral vasodilation was the focus of a study by Barabasz and McGeorge (1978). They divided 73 university students into four experimental groups (A, B, C, & D) aimed at increasing hand temperature. Group A consisted of auditory temperature biofeedback, but without autogenic phrases or verbal suggestions provided to the subject to assist in the hand warming process. Group B was a false feedback control group, where subjects were told to lower an auditory tone by increasing surface temperature, but the presented tone was a continuous recording set at the same level and frequency as initially received by group A. Group C was a relaxation control group, receiving audiotaped instructions of relaxation procedures. Finally, group D was a hypnosis group in which subjects were presented with hand warming imagery and direct suggestions. The experimental session for each group consisted of a 5 minute baseline recording period and then 10 minutes of treatment. The results of this brief experiment demonstrated that hypnosis was the only modality which had a significant effect on peripheral vasodilation, while groups A - C did not provide a significant differential from baseline to the end of the session. This provides evidence for the effectiveness of hypnosis in promoting peripheral vasodilation in a briefly presented format. Voluntary control over the autonomic nervous system through the use of hypnosis illustrates the possibility of its use in the therapeutic management of physiological disorders needing enhanced blood flow.

Hypnosis has been highly effective in the treatment of disorders requiring vasodilation (Conn & Mott, 1984; Moore & Kaplan, 1983). In a study of five patients presenting with symmetrical or bilaterally equivalent burn wounds (four with hand burns and one with thigh burns) (Moore & Kaplan, 1983), hypnosis was used to facilitate the healing process. Each subject was put into a trance state and instructed to enhance blood flow to a portion of their wounded body. Temperatures were recorded from this site, as well as from the adjacent wounded area where hypnosis was not used in the treatment process. In four of the patients, the side with the hypnotically enhanced blood flow demonstrated clearly accelerated healing, while with the fifth patient, vasodilation and enhanced healing was achieved in both hands. This demonstrates the effectiveness of hypnosis in producing a vasodilatory response while in a trance state, and its ability to produce a positive change in a physical malady.

Hypnosis has also been used successfully in the treatment of Raynaud's disease. Conn and Mott (1984) present a case study of a highly hypnotizable 27-year-old female subject who had been afflicted with Raynaud's disease for three years. A progressive relaxation technique was used to induce a trance state, and then suggestions of visualizing and enhancing the circulation in her hands were initiated. She was to practice this technique at home between weekly sessions, along with instructed self-hypnosis. It was found that enhanced vasodilation began to occur after 20 seconds of the hypnotic suggestions to open up her blood vessels, and that blood volume had increased four fold after 45 seconds. When these same suggestions were made to the patient when she was not in the trance state, there was no change in vasodilation. This additionally presents the capability of hypnosis to interact with a physiological process in the treatment of a medical disorder.

The literature containing studies using hypnotic procedures in the treatment of essential hypertension is sparse. The research that has been completed tends to study hypnosis from a relaxation point of view only, and not as a possible technique for promoting peripheral vasodilation. This is not to say that hypnosis has not met with successful results in hypertensive patients, but whether it is reaching its full physiological treatment capabilities in its present use is of concern. An example of this has been found in a study comparing the use of blood pressure feedback, hypnosis, and the two procedures combined, in the treatment of hypertension (Friedman & Taub, 1977). A total of 48 medicated and unmedicated patients presenting with essential hypertension underwent the Stanford Hypnotic Susceptibility Scale, Form A. Those individuals scoring in the high susceptibility range were randomly assigned to either a hypnosis only group or a combined biofeedback/hypnosis treatment group. The remaining patients, as well as some of the high susceptibility scorers, were placed in a biofeedback only group or a blood pressure measurement control group. All subjects participated in seven 15 minute training sessions over a four week period. At each session 15 blood pressure readings were taken at 1 minute intervals. In the hypnosis group, patients were told to relax and to sit quietly and comfortably, while in a state of hypnosis. In the biofeedback group the patients were told to observe the last number lit on the blood pressure feedback machine (diastolic reading) and to attempt to lower this number, without receiving any instructions on how to accomplish this feat. Those individuals in the combined hypnosis/biofeedback group received the same instructions as those patients in the biofeedback group, but they were in a state of hypnosis. The control group had the experimenter record the 15 blood pressure measurements at each session, and they were not exposed to any of the treatment modalities. Follow-up data was collected at one week and one month posttreatment.

Results demonstrated the effectiveness of hypnosis presented in a physiologically nonspecific manner. Only those individuals in the hypnosis group displayed a significant reduction in diastolic blood pressure. Those patients in the other three groups displayed a nonsignificant trend in the positive direction, and they did not differ significantly from one another. Follow-up data also revealed that the hypnosis group was the only one which maintained this improvement at one month posttreatment, suggesting that this modality maintains its effectiveness longer than the other treatments observed in this study.

Friedman and Taub (1978) also conducted a six month posttreatment follow-up of this investigation, completed at monthly intervals with no use of hypnosis or biofeedback. Again, the hypnosis group was the only group which displayed a significant decrement in diastolic blood pressure when compared with baseline measures, and was the only group which differed significantly from the measurement only control group. While this shows promise for the clinical usefulness of hypnosis in the treatment of hypertension, its presentation in this study does not distinguish whether the effects are due to its ability passively to relax each patient or if some intrinsic physiological event is determining the drop in blood pressure. To investigate this possibility, hypnosis would have to be compared with progressive muscle relaxation to determine effectiveness in reducing blood pressure, and hypnotic suggestions should focus on influencing the peripheral vasculature.

Hypertensive patients, whether medicated or not, were able to lower their diastolic and systolic blood pressures to normal levels within two-to-three sessions of hypnosis training, during an investigation into the use of hypnosis and relaxation in lowering hypertensive blood pressure levels (Deabler, Fidel, Dillenkoffer, & Elder, 1973). Twenty-one patients were used in this study (6 unmedicated control subjects, 6 unmedicated treatment subjects, and 9 medicated treatment subjects), with those individuals receiving treatment being subjected to 9 sessions of progressive muscle relaxation and hypnosis. Each treatment session consisted of a short blood pressure reading interval followed by the progressive muscle relaxation, then another blood pressure reading followed by hypnosis focusing on inner relaxation and drowsiness, then another blood pressure reading before a second hypnotic deepening phase focusing on relaxing internal organs, such as the heart and blood vessels, and concluding with a final measurement of blood pressure. Those subjects in the control group underwent 7 sessions of blood pressure measurements only. The results indicated that progressive muscular relaxation and hypnosis were both effective in reducing hypertensive blood pressure levels, but that hypnosis was significantly superior to the relaxation phase. This study used a physiological approach to the hypnotic induction, where there was a focus on relaxing internal organs, and this may very well have contributed to the significant reductions in blood pressure by inadvertently promoting peripheral vasodilation. However a confound exists in this study, due to the fact that hypnosis was always presented last to the treatment subjects, and the lower pressures may be related to a treatment time factor. If half of the subjects had received hypnosis first followed by the relaxation protocol, then this would have removed the confound and given the hypnotic effects more credibility.

Since thermal biofeedback has been the most promising behavioral intervention for hypertension, and with hypnosis providing similar physiological effects on peripheral blood flow, the treatment literature requires a study investigating the effectiveness of these two strategies with a group of hypertensives who fall into the high sympathetic nervous system activity category. The hypnotic suggestions would have to focus on physiological factors such as promoting peripheral vasodilation and reducing sympathetic nervous system activity. This would provide an examination of whether or not these two modalities can promote a significant change on the physiological indices of essential hypertension in this population. It is the purpose of this study to lower diastolic and systolic blood pressure and heart rate in medicated and unmedicated essential hypertensive patients, 45 years of age or younger, by reducing peripheral sympathetic nervous system activity through the use of hypnosis and thermal biofeedback, thereby facilitating vasodilation in the periphery. Since both of these treatment strategies are concentrating on the same physiological process (promoting vasodilation in the periphery), a comparison of their effectiveness will be conducted.

Method

Subjects

Twenty-one patients from the Family Practice Unit, Health Sciences Centre, St. John's, Newfoundland, who had been diagnosed with essential hypertension (diastolic blood pressure at 95 mmHg or greater and/or systolic blood pressure at 140 mmHg or greater) by their physician, and were 45 years of age or younger, were each mailed a form letter and postage-paid self-addressed response card for inclusion in an eight-week nonpharmacological treatment study. Eight subjects (6 male, 2 female) ranging in age from 24 to 45 (mean age, 39.6), returned a positive reply and were contacted by the experimenter in order to obtain written informed consent and begin baseline measures. Six of the subjects were currently taking medication to control their blood pressure, and medication and/or dosage were not changed during the study. At the initial session all patients were instructed not to alter their diet, weight, or activity level for the duration of their involvement in the study so as not to confound the data.

Apparatus

All subjects had their heart rate measured using an electrocardiograph (EKG)(Hewlett-Packard, Model 1504B), with limb lead electrode placements. Blood pressure measurements were taken with a mercury sphygmomanometer and stethoscope, using adult size (25-35 cm.) and large arm size (33-47 cm.) blood pressure cuffs (Baumanometer Calibrated V-Lok Cuff). All subjects had their skin temperature changes monitored by an electronic thermal biofeedback machine (Cyborg Corp, Model P442), using a digital display output from a thermistor attached to the subject's finger or toe, calibrated to one-tenth of a degree fahrenheit. A small cardboard-backed thermometer (Thought Technology, Absolute Thermometer) was used for home practice of skin temperature training.

Treatment Modalities

Thermal Biofeedback. Treatment in this group consisted of skin-temperature training over eight sessions on a twice-per-week basis, for the purpose of enhancing peripheral vasodilation, by warming their hands and feet. A thermistor was attached by velcro to the dorsal side of the index finger on each subject's nondominant hand (sessions 1-5) or the dorsal side of the second toe (sessions 6-8) on the same side of the body, and connected to the biofeedback machine which displayed a digital output of temperature change in degrees fahrenheit. During the first two sessions the experimenter provided autogenic suggestions (adapted from Jencks, 1977) of relaxation, heaviness, and warmth in the extremities to promote the warming response (see Appendix A). Beginning at session three each subject was left to their own individual methods for achieving a peripheral temperature change. A cardboard-backed thermometer was issued to each subject and was to be used for daily 20-minute between sessions home practice during their involvement in this phase.

Hypnosis. During treatment in this modality, each subject completed 8 sessions over four weeks, during which they underwent a hypnotic trance induction using an Eye Fixation with Progressive Relaxation technique, Deepening by Arm Levitation and Arm Heaviness (adapted from Waxman, 1989), and a Blood Perfusion Protocol (adapted from Moore, 1990)(including imagery for perfusion and posthypnotic suggestions focusing on increased ease and depth in subsequent hypnotic sessions, and continued perfusion between sessions) (Appendix B). Hypnotic sessions focused on increasing blood flow to the extremities as a method for enhancing peripheral vasodilation. The first five sessions concentrated on blood perfusion in the nondominant-hand, while the latter three sessions focused on the foot of the same side of the body as the hand.

Procedure

Various physicians in the St. John's area were contacted in an attempt to locate patients 45 years of age or younger with a diagnosis of essential hypertension. During this contact, the nature and purpose of the study was explained to the physicians and they were requested to forward the names and addresses of any patients who matched the aforementioned characteristics, for possible inclusion in this study. Working through Dr. Roger Butler, Family Practice Unit, Health Sciences Centre, St. John's, 21 patients were contacted, of which 8 replied favourably. Dr. Butler was instructed to try to maintain each subject's pharmacological regimen unchanged, to reduce the chance of confounding the data. These eight subjects were each contacted by the experimenter and an initial appointment was made to secure written informed consent and to begin baseline measures. All sessions were conducted at the Department of Psychology's teaching clinic, Memorial University of Newfoundland, on an individual basis, in a private interviewing room. During the first appointment the treatment methods and purpose of the experiment were explained to the subjects, and that as volunteers in an experiment they had the right to refuse participation at any time. Following this explanation all questions were answered and written informed consent was obtained (see Appendix C).

During the first appointment the initial baseline measurements were obtained. Each subject was seated in a reclining chair while the experimenter attached electrodes to the subject's forearms and lower legs (inside of calf muscle), which were held in place with rubber straps. These electrodes were connected to an electrocardiograph and remained attached to the subject for the duration of each session of the entire study. The subject was then told to recline in the chair and that the experimenter would return to the room in 15 minutes to obtain blood pressure readings. Following 15 minutes the experimenter took two blood pressure readings from the subject's nondominant arm (left arm in all subjects), and then left the room for another 10 minutes. At this time (25 minutes into baseline session) the experimenter recorded a 30 second printout of the subject's heart rate. Another 10 minutes elapsed (35 minutes into baseline session) and then the experimenter again re-entered the room and obtained another 30 second heart rate recording and two more blood pressure readings. This concluded the baseline session and the mean heart rate and systolic and diastolic blood pressures were then calculated and recorded for that session. Each subject underwent five baseline sessions, each occurring twice per week, two-and-a-half weeks prior to the treatment phase. No two sessions ever occurred on consecutive days for any subject during the time period of the study.

At the end of the fourth baseline session, each subject underwent the Stanford Hypnotic Susceptibility Scale, Form A (SHSS-A) (Weitzenhoffer & Hilgard, 1959). This was conducted by the experimenter and consisted of 12 items for examining how susceptible each subject was to hypnosis. The initial 10-15 minutes of this procedure focused on establishing rapport with the subject, including the removal of any doubts or fears the subject may have held regarding hypnosis. For the remainder of the session the experimenter was seated slightly behind the subject, out of the range of vision, and administered the 12 items of the scale. Based on performance, each subject was classified as either having low, medium, or high susceptibility to hypnosis, and their score was recorded for posttreatment analysis. Following the fifth baseline session each subject was randomly assigned, using a random numbers table based on their patient identification number, to one of two groups, hypnosis/biofeedback or biofeedback/ hypnosis. A control group was not necessary since all of the subjects received both types of treatment, and therefore served as their own controls.

Half of the subjects underwent eight sessions of hypnosis training over four weeks, followed by eight sessions of biofeedback training over four weeks, while the other half of the subjects were subjected to biofeedback prior to the hypnotic protocol. Those subjects in the biofeedback phase were seated in a recliner chair in a private interviewing room at the clinic for each session of this modality. During the first two sessions the experimenter was present in the room with each subject during the feedback training, in order to provide autogenic suggestions of relaxation, heaviness, and warmth in the extremities, for assistance in promoting increased skin-temperature. At session three each subject was left alone during the feedback training and was responsible for choosing their own method of achieving peripheral temperature change. The format for each biofeedback session was as follows:

-Discussion of home practice, problems, and establishing rapport while attaching thermistor and EKG electrodes. (5 min.)

-Adaptation to surroundings while the experimenter was out of the room. (10 min.)

-In-session baseline, where feedback is not available to the subject. (5 min.)

-Self-control 1 (subject attempted peripheral temperature change without feedback). (5 min.)

-Feedback training (subject attempted peripheral temperature change with visual feedback). (20 min.)

-Self-control 2 (subject was again requested to achieve peripheral temperature change without feedback).(5 min.)

-EKG and blood pressure readings, followed by a discussion of the session while disconnecting the thermistor and EKG electrodes. (5 min.)

Total Time: 55 min.

The first five sessions focused on increasing the surface temperature of the hand, while the final 3 sessions concentrated on the foot. The experimenter recorded the baseline temperature and the highest temperature obtained during the feedback training phase for each subject at every biofeedback session. At the end of the first biofeedback session each subject was given a cardboard-backed thermometer and instructions on its use for daily 20-minute between sessions home practice.

During the hypnosis phase of the treatment protocol, each subject was seated in a reclined chair in a private interviewing room. The format for each hypnosis session was as follows:

-Discussion of any questions the subject may have presented and establishing rapport while attaching the EKG electrodes. (5 min.)

-Adaptation to surroundings while the experimenter was out of the room. (10 min.)

-Hypnotic induction, deepening, and blood perfusion imagery and post-hypnotic suggestions. (25 min.)

-EKG and blood pressure readings, followed by a discussion of the session and a return to pre-hypnotic alertness. (5 min.)

Total Time: 45 min.

The blood perfusion protocol focused on imagery in the arm and hand during the first five sessions, and was switched to the leg and foot during the final three sessions.

At the completion of the eight week treatment phase all subjects were required to return to the clinic for four weekly posttreatment evaluations of their heart rate and diastolic and systolic blood pressure. The posttreatment evaluations followed the same procedures used in the baseline appraisal, and no use of biofeedback or hypnosis was involved during this process.

Results

Data on the three dependent variables (diastolic blood pressure, systolic blood pressure, and heart rate) were collected from the final four sessions of each time point in the study, since it was felt that this would provide a true measure of the subjects' response to that phase, without interference from the previous study phase. This provided 16 data points for each subject with the 4 points at each of the 4 phases of the study being summed and the total used as the subject's score for that period. A two-way analysis of variance (study groups x time points), with repeated measures, was performed for each of the three dependent variables. There were two study groups (hypnosis/biofeedback and biofeedback/hypnosis) and four time points in the study (baseline, treatment one, treatment two, and posttreatment). The analyses displayed a significant main effect for time points for diastolic blood pressure (F (3, 18) = 25.57, p<.001)(see Table 1), a significant main effect for time points for systolic blood pressure (F (3, 18) = 7.21, p<.005)(see Table 2), and a main effect for time points for heart rate (F (3, 18) = 7.05, p<.005)(see Table 3).

Table 1

Analysis of Variance Summary Table for Diastolic Blood Pressure

Source	Sum of Squares	df	Mean Square	F ratio	p
Total	10958.47	31			
Between Subjects	3561.72	7			
Groups	957.03	1	957.03	2.21	ns
Error b	2604.69	6	434.12		
Within Subjects	7396.75	24			
Time Points	5860.1	3	1953.67	25.57	$<.001$
Time Points X Groups	160.09	3	53.7	0.7	ns
Error w	1375.56	18	76.42		

Table 2

Analysis of Variance Summary Table for Systolic Blood Pressure

Source	Sum of Squares	df	Mean Square	F ratio	p
Total	23553.47	31			
Between Subjects	15199.72	7			
Groups	5382.03	1	5382.03	3.29	ns
Error b	9817.69	6	1636.28		
Within Subjects	8353.75	24			
Time Points	4408.6	3	1469.53	7.21	<.005
Time Points X Groups	275.59	3	91.86	0.45	ns
Error w	3669.56	18	203.86		

Table 3

Analysis of Variance Summary Table for Heart Rate

Source	Sum of Squares	df	Mean Square	F ratio	p
Total	107356	31			
Between Subjects	86816	7			
Groups	91.13	1	91.13	0.01	ns
Error b	86724.87	6	14454.15		
Within Subjects	20540	24			
Time Points	9930	3	3310	7.05	$<.005$
Time Points X Groups	2159.37	3	719.79	1.53	ns
Error w	8450.63	18	469.48		

The "Time Points" main effect for each dependent variable was analyzed using Tukey's method. For diastolic blood pressure the results indicated that treatment one, treatment two, and posttreatment were significantly different from baseline (Q (4, 18) = 15.73, $p<.01$) (see Table 4). The results for systolic blood pressure demonstrated that treatment one significantly differed from baseline (Q (4, 18) = 20.2, $p<.05$), and that treatment two and posttreatment also differed from baseline (Q (4, 18) = 25.7, $p<.01$) (see Table 5). Finally, the analysis for heart rate exhibited a significant difference between posttreatment and the two treatment phases (Q (4, 18) = 38.99, $p<.001$) (see Table 6). The difference in heart rate during the posttreatment period is of great interest because it is an increase greater than that found in all of the other study phases, although not in the predicted direction. The significant differences found for the main effects in the systolic and diastolic blood pressure analyses were in the predicted direction.

The means of the two treatment groups were recorded to provide an examination of the changes of the three dependent variables over the course of the study. The diastolic blood pressure means (in mmHg) for the hypnosis/biofeedback group from baseline through to posttreatment were 90.81, 84.25, 83.13, and 83.63, respectively. For the biofeedback/hypnosis group, the ordered means were 93.81, 88.13, 84, and 86.25 (see

Table 4

Results of the Tukey's Method Performed on the Diastolic BP Time Points Main Effect

Table of Mean and Mean Differences

	Time Points			
	Baseline (369.25)	Treatment 1 (344.75)	Treatment 2 (334.25)	Posttreatment (338.63)
Baseline (369.25)	----	24.5**	35**	30.62**
Treatment 1 (344.75)		----	10.5	6.12
Treatment 2 (334.25)			----	4.38
Posttreatment (338.63)				----

*$p < .05$
**$p < .01$

Note: Each value in the table represents the difference between the column and row values.

Table 5

Results of the Tukey's Method Performed on the Systolic BP Time Points Main Effect

Table of Means and Mean Differences

	Time Points			
	Baseline (527)	Treatment 1 (501.5)	Treatment 2 (500.5)	Posttreatment (498.13)
Baseline (527)	----	25.5*	26.5**	28.87**
Treatment 1 (501.5)		----	1	3.37
Treatment 2 (500.5)			----	2.37
Posttreatment (498.13)				----

*$p < .05$
**$p < .01$

Note: Each value in the table represents the difference between the column and row values.

Table 6

Results of the Tukey's Method Performed on the Heart Rate Time Points Main Effect

Table of Means and Mean Differences

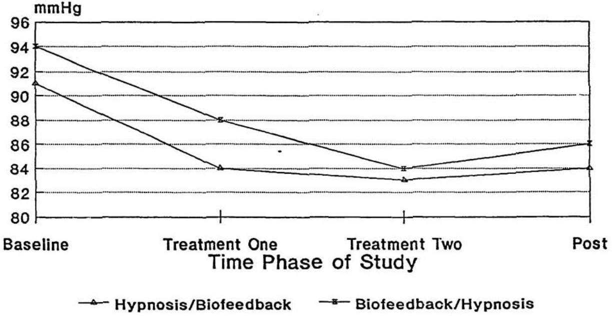
	Time Points			
	Baseline (344)	Treatment 1 (322.5)	Treatment 2 (319.5)	Posttreatment (363)
Baseline (344)	----	21.5	24.5	19
Treatment 1 (322.5)		----	3	40.5**
Treatment 2 (319.5)			----	43.5**
Posttreatment (363)				----

*$p < .05$
**$p < .01$

Note: Each value in the table represents the difference between the column and row values.

Figure 1

Mean Diastolic Blood Pressure Observations Between Treatment Groups



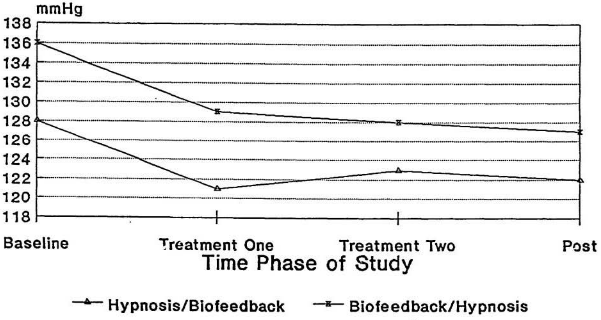
The difference between groups is whether hypnosis or biofeedback is presented at treatment one or treatment two.

Figure 1). The systolic blood pressure means (in mmHg) from baseline to posttreatment for the hypnosis/biofeedback group were 127.81, 121.38, 122.75, and 121.88. For the biofeedback/hypnosis group the means were 135.69, 129.38, 127.5, and 127.19, respectively through the four study phases (see Figure 2). Finally, for heart rate, the means (in beats per minute) of the hypnosis/biofeedback group across the four longitudinal points were 83.25, 80.5, 78.31, and 93.5, respectively. While the means for the biofeedback/hypnosis group over the time phases of the study were 88.75, 80.75, 81.44, and 88, respectively (see Figure 3).

In order to investigate whether or not a subject's level of hypnotic susceptibility was related to their performance during the hypnotic treatment phase, Pearson's product-moment correlation coefficient was used to analyze the data for each dependent variable. The score that each subject received on the Stanford Hypnotic Susceptibility Scale, Form A (Weitzenhoffer and Hilgard, 1959) was compared with their performance during the hypnotic treatment session. The hypnotic treatment performance data were obtained by computing each subject's results during the last four hypnotic sessions and using the difference between these results and their final four baseline measures. Diastolic blood pressure was the only dependent variable to show a significant correlation between hypnotic susceptibility and performance during the hypnotic

Figure 2

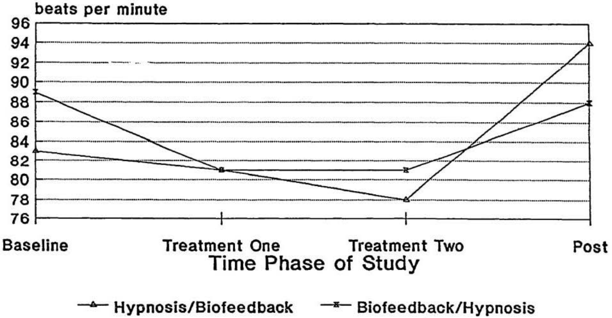
Mean Systolic Blood Pressure Observations Between Treatment Groups



The difference between groups is whether hypnosis or biofeedback is presented at treatment one or treatment two.

Figure 3

Mean Heart Rate Observations Between Treatment Groups



The difference between groups is whether hypnosis or biofeedback is presented at treatment one or treatment two.

treatment phase (r = 0.91, p<.01). Although a significant correlation was not obtained for systolic blood pressure (r = 0.62), the linear relationship between the two variables was in the expected direction. This cannot be said of the nonsignificant result obtained during the heart rate analysis (r = -0.39). The mean hypnotic susceptibility score of the eight subjects was 5, which is classified under medium susceptibility. The breakdown of the eight susceptibility scores placed two subjects in the high classification, one in the medium category, and the other five in the low range.

Pearson's r was also computed on the three dependent variables to examine the relationship between each subject's ability to increase their surface temperature in the periphery, and their performance during the biofeedback treatment phase of the study. The difference in temperature between baseline and feedback training during each of the last four biofeedback sessions was used as an indication of thermal performance for each subject. Performance data for the dependent variables between baseline and the biofeedback phases for each subject was obtained using the same procedure as that used in the hypnotic correlational analysis, with the data being collected from the final four sessions of the respective study periods. There were no significant correlations found for thermal performance on diastolic blood pressure (r = 0.09), systolic blood pressure (r = -0.03), or heart rate (r = -0.47).

For all of the eight subjects, the mean finger temperature during the five finger biofeedback sessions was 89.47, with a mean increase of 2.43 degrees from baseline to the end of the feedback present training phase. The mean toe temperature over the three biofeedback sessions was 80.24 degrees, with the mean increase from baseline to feedback training equalling 2.09 degrees.

Discussion

The goal of this study was to investigate whether the treatment modalities of hypnosis and thermal biofeedback could have a significant impact on lowering the physiological indices of essential hypertension in patients who met the criteria for heightened sympathetic nervous system arousal. In particular, it was expected that by enhancing peripheral vasodilation, through the use of these nonpharmacological strategies, that a subsequent reduction in diastolic and systolic blood pressures, and heart rate would follow. Since these two treatment modalities were concentrating on the same physiological process (promoting vasodilation in the periphery), an analysis of their effectiveness was conducted.

The results of the data analyses appear to support the expectations of the study. Both treatment groups demonstrated significant decreases of diastolic and systolic blood pressures over the course of the study, when the two treatment phases and the posttreatment period were compared against the baseline measures. No significant statistical differences were detected between these two treatments, and they were similar in regard to outcome measures. The equality of these interventions does support the idea that they share a common procedure in the vasodilatory response of these hypertensive subjects. However, an inability to detect a difference between these two modalities may have resulted from the small sample size utilized in this study.

The observed main effect of biofeedback and hypnosis over the time phases of this study on diastolic and systolic blood pressures demonstrates the efficacy of these two modalities when presented in a short time frame. Many of the studies employing thermal biofeedback procedures in the treatment of essential hypertension have used 16 sessions over an eight week period (Blanchard et al., 1984; Blanchard et al., 1986; McCoy et al., 1988), while the hypnosis studies have lacked the repeated physiological measures that this study utilizes so that it is not possible to evaluate the length of their treatment protocols. From the results of this study, it can be concluded that a four-week 8 session presentation of either treatment was all that was needed to initiate significant reductions in diastolic and systolic blood pressure. Although the posttreatment period was short (one month), the emphasis of this study was to examine whether or not hypnosis and biofeedback could yield equal and effective influences on the sympathetic indices of hypertension, and the brief posttreatment phase served its purpose in displaying the short-term efficacy of these procedures. Obviously a lengthy follow-up term would provide important clinical data in determining the long-term effects of these procedures when presented in a brief time frame.

It could also be argued by some that neither treatment was effective in lowering the dependent variables, but that the drop in blood pressure was due only to the repeated measures over the course of the study. While the lack of a control group, due to the small sample size of this study, makes it difficult to deal with this possibility from the obtained data, previous studies have not shown a significant longitudinal effect for control groups receiving only repeated blood pressure assessments (Deabler et al., 1973; Friedman & Taub, 1977). Therefore, it is assumed that the significant changes in blood pressure found in this study were due to the introduction of the treatment modalities.

While both levels of blood pressure were significantly reduced, the expectation that heart rate would also decrease with vasodilation, due to reduced cardiac output, did not meet with the same outcome. Heart rate did decrease during the two treatment phases when compared to baseline, although not significantly, but it is the analysis of this measure during posttreatment that is of concern. For both treatment groups, heart rate significantly increased during posttreatment when it was compared with the two treatment measures. There is no evidence of this phenomenon contained in the other studies employing these two procedures, and therefore its occurrence appears unique. If an increased blood flow, due to the subjects' new ability to initiate peripheral vasodilation, was responsible for the elevation in heart rate (i.e., the Bainbridge reflex) (Smith & Kampine, 1984), then heart rate would have been expected to increase during the treatment phases, when vasodilation was initiated through biofeedback and hypnosis. Since this was not the case, it is believed that when treatment was terminated an initial increase in plasma catecholamines may have occurred, due to the removal of the therapeutic interventions and a slight return to basal vasoconstrictive levels (as evidenced by an elevation in diastolic blood pressure during the posttreatment phase), which had a greater effect on the beta-1 receptors of the heart than the alpha and/or beta-2 receptors located in the vasculature. This is only a hypothesis: for it to be examined thoroughly an extended posttreatment would have to be conducted to observe whether heart rate and blood pressure would continue to increase, as with the obese individual who gains more weight after their dietary intervention has concluded, or whether an eventual plateau effect would occur, where heart rate and blood pressure levels would stabilize at a measure between baseline and treatment levels. Also, an examination of circulating catecholamines would have to be carried out to test this hypothesis completely.

Thermal biofeedback and hypnosis both demonstrated equal efficacy in the reduction of the dependent variables of this study, leading one to believe that they both acted upon the same physiological principles in achieving this end. However, when correlational analyses were completed between each subject's performance regarding the dependent variables, and each subject's level of hypnotic susceptibility and thermal performance during feedback training, positive linear relationships were present only for hypnotic susceptibility and diastolic and systolic blood pressures. The linear relationships for thermal performance were near zero for both levels of blood pressure. This leads to the belief that a factor other than the thermal training may be responsible for invoking the reduction in blood pressure during the biofeedback intervention. When Barabasz and McGeorge (1978) compared the use of auditory thermal biofeedback without the use of autogenic phrases or formal suggestions and the use of hypnosis presented with suggestions of hand warming, it was found that thermal biofeedback had no significant effect on skin temperature. Hypnosis, however, did promote significant peripheral vasodilation, suggesting that the removal of autogenic suggestions of warmth in the periphery may decrease the effectiveness of thermal biofeedback. Autogenic suggestions of relaxation, heaviness, and warmth in the extremities are presented to the subjects in this study, and may be the influencing factor promoting peripheral vasodilation during the biofeedback intervention.

The influence of autogenic suggestions may also explain some of the success experienced by the subjects during the hypnotic treatment phase. While positive linear relationships existed between the hypnotic susceptibility of the subjects and their blood pressure levels during hypnosis (therefore producing greater treatment effects for those with higher hypnotic susceptibility scores), the fact that only three of the eight subjects scored above the low susceptibility range while both treatment groups recorded significant drops in diastolic and systolic blood pressures during the hypnosis intervention, demonstrated that any level of hypnotic susceptibility appeared to be sufficient for beneficial consequences during this treatment modality. While the low susceptibility individuals achieved a reduction in blood pressure levels, it may be deduced that they were reacting to the formal hypnotic suggestions of increased blood flow and warmth in the periphery, in the same manner as they attended to the autogenic suggestions in the biofeedback intervention.

Therefore, the power of suggestion when presented with a physiologically specific content seems to be enough to invoke internal processes such as peripheral vasodilation. Incorporating a group which only receives autogenic suggestions focused on peripheral vasodilation would further examine the power of such an intervention in comparison with thermal biofeedback and hypnosis. Whatever the outcome of such a study, it must be noted that with the similar results of the two interventions included in this study, the success of hypnosis without the expensive equipment required for biofeedback training should place a favourable light on its use as the behavioral treatment of choice for essential hypertension.

Finally, Fahrion et al. (1986) described a criterion for thermal performance as the ability to achieve a hand temperature of 95°F and a foot temperature of 93°F. In the present study the mean hand temperature for all of the subjects was 89.47°F and 80.24°F for their mean foot temperature. Not one of the patients in this study was able to meet the criterion presented by Fahrion et al., (1986), yet both treatment groups achieved significant results during the biofeedback phase of the study, which casts doubt upon the usefulness of this criterion.

This investigation should be treated as a preliminary study, attempting to examine the psychophysiological utility of two noninvasive stress management interventions. Although the sample size was small, significant results were obtained in the expected direction for blood pressure levels using groups containing medicated and unmedicated subjects who fell into the age group where heightened sympathetic arousal was suspected. This demonstrates the utility of these interventions as an alternative, side-effect free treatment for elevated blood pressure levels and/or as an adjunct with pharmacological therapy. As discussed above, all is not perfect with the results of this investigation, and future research must focus on the elevated heart rate observed during posttreatment. A lengthy posttreatment period of six months to one year should establish whether or not the heart rate would stabilize over time or continue to increase. Also, baseline and posttreatment measures of plasma catecholamines should be conducted to account for this factor. Obviously, if an increase in heart rate continued then the utility of these interventions would be in doubt. Finally, the inclusion of a group receiving only autogenic suggestions of vasodilation would clarify whether or not this is the active ingredient for behavioral interventions, nullifying the use of elaborate equipment or technical devices. Research of this nature is important for the large group in today's society who would prefer a limited pharmacological presence in the treatment of their maladies.

References

Anderson, E., Sinkey, C., Lawton, W., & Mark, A. (1989). Elevated sympathetic nerve activity in borderline hypertensive humans: Evidence from direct intraneural recordings. Hypertension, 14, 177-183.

Barabasz, A.F., & McGeorge, C.M. (1978). Biofeedback, mediated biofeedback and hypnosis in peripheral vasodilation training. The American Journal of Clinical Hypnosis, 21, 28-37.

Beaumont, J.G. (1988). Understanding neuropsychology. New York: Basil Blackwell Ltd.

Blanchard, E.B., McCoy, G.C., Andrasik, F., Acerra, M., Pallmeyer, T.P., Gerardi, R., Halpern, M., & Musso, A. (1984). Preliminary results from a controlled evaluation of thermal biofeedback as a treatment for essential hypertension. Biofeedback and Self-Regulation, 9, 471-495.

Blanchard, E.B., McCoy, G.C., Musso, A., Gerardi, M.A., Pallmeyer, T.P., Gerardi, R.J., Cotch, P.A., Siracusa, K., & Andrasik, F. (1986). A controlled comparison of thermal biofeedback and relaxation training in the treatment of essential hypertension: I. Short-term and long-term outcome. Behavior Therapy, 17, 563-579.

Blumenthal, J.A. (1985). Relaxation therapy, biofeedback, and behavioral medicine. Psychotherapy, 22, 516-530.

Carruthers, S.G., & Dean, C.R. (1990). Diuretics. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 108-116). Toronto: Grosvenor House Press Inc.

Conn, L., & Mott, T. (1984). Plethysmographic demonstration of rapid vasodilation by direct suggestion: A case of raynaud's disease treated by hypnosis. American Journal of Clinical Hypnosis, 26, 166-170.

Deabler, H.L., Fidel, E., Dillenkoffer, R.L., & Elder, S.T. (1973). The use of relaxation and hypnosis in lowering high blood pressure. The American Journal of Clinical Hypnosis, 16, 75-83.

de Champlain, J., Petrovich, M., Gonzalez, M., Lebeau, R., & Nadeau, R. (1991). Abnormal cardiovascular reactivity in borderline and mild essential hypertension. Hypertension, 17(Suppl. III), 22-28.

Drummond, P.D. (1983). Cardiovascular reactivity in mild hypertension. Journal of Psychosomatic Research, 27, 291-297.

Fahrion, S., Norris, P., Green, A., Green, E., & Snarr, C. (1986). Biobehavioral treatment of essential hypertension: A group outcome study. Biofeedback and Self-Regulation, 11, 257-277.

Fredrickson, M., & Engel, B.T. (1985). Cardiovascular and electrodermal adjustments during a vigilance task in patients with borderline and established hypertension. Journal of Psychosomatic Research, 29, 235-246.

Fredrickson, M., & Matthews, K.A. (1990). Cardiovascular responses to behavioral stress and hypertension: A meta-analytic review. Annals of Behavioral Medicine, 12, 30-39.

Freedman, R.R. (1987). Long-term effectiveness of behavioral treatments for Raynaud's disease. Behavior Therapy, 18, 387-399.

Freedman, R.R., Ianni, P., & Wenig, P. (1983). Behavioral treatment of Raynaud's disease. Journal of Consulting and Clinical Psychology, 51, 539-549.

Friedman, H., & Taub, H.A. (1977). The use of hypnosis and biofeedback procedures for essential hypertension. The International Journal of Clinical and Experimental Hypnosis, 25, 335-347.

Friedman, H., & Taub, H.A. (1978). A six-month follow-up of the use of hypnosis and biofeedback procedures in essential hypertension. The American Journal of Clinical Hypnosis, 20, 184-188.

Goldstein, D.S. (1981). Plasma norepinephrine during stress in essential hypertension. Hypertension, 3, 551-556.

Goldstein, D.S. (1983). Plasma catecholamines and essential hypertension: An analytical review. Hypertension, 5, 86-99.

Goldstein, D.S., Lake, C.R., Chernow, B., Ziegler, M.G., Coleman, M.D., Taylor, A.A., Mitchell, J.R., Kopin, I.J., & Keiser, H.R. (1983). Age-dependence of hypertensive-normotensive differences in plasma norepinephrine. Hypertension, 5, 100-104.

Henry, J.P. (1988). Stress, salt and hypertension. Social Science Medicine, 26, 293-302.

Jacob, R.G., Wing, R., & Shapiro, A.P. (1987). The behavioral treatment of hypertension: Long term effects. Behavior Therapy, 18, 325-352.

Jencks, B. (1977). Your body: Biofeedback at its best. Chicago: Nelson Hall.

Julius, S., & Bassett, D.R. (Eds.). (1987). Handbook of hypertension: Behavioral factors in hypertension (Vol. 9). New York: Elsevier Science Publishing Co.

Kaplan, N.M., Brenner, B.M., & Laragh, J.H. (Eds.). (1989). Perspectives in hypertension: New therapeutic strategies in hypertension (Vol. 3). New York: Raven Press.

Kaufmann, P.G., Chesney, M.A., & Weiss, S.M. (1991). Behavioral medicine in hypertension: time for new frontiers? Annals of Behavioral Medicine, 13, 3-4.

Kopin, I.J., McCarty, R., & Yamaguchi, I. (1980). Plasma catecholamines in human and experimental hypertension. Clinical and Experimental Hypertension, 2, 379-394.

Levine, M., & Fodor, G. (1990). High blood pressure and the human body. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 11-29). Toronto: Grosvenor House Press Inc.

Mann, A.H. (1986). The psychological aspects of essential hypertension. Journal of Psychosomatic Research, 30, 527-541.

McCoy, G.C., Blanchard, E.B., Wittrock, D.A., Morrison, S., Pangburn, L., Siracusa, K., & Pallmeyer, T.P. (1988). Biochemical changes associated with thermal biofeedback treatment of hypertension. Biofeedback and Self-Regulation, 13, 139-150.

Menkes, M.S., Matthews, K.A., Krantz, D.S., Lundberg, U., Mead, L.A., Qaqish, B., Liang, K-Y., Thomas, C.B., & Pearson, T.A. (1989). Cardiovascular reactivity to the cold pressor test as a predictor of hypertension. Hypertension, 14, 524-530.

Moore, L.E. (1990). Blood Perfusion Protocol. In D.C. Hammond (Ed.), Handbook of hypnotic suggestions and metaphors (p. 246). New York: W.W. Norton & Co.

Moore, L.E., & Kaplan, J.Z. (1983). Hypnotically accelerated burn wound healing. American Journal of Clinical Hypnosis, 26, 16-19.

Myers, M. (1990). Drug therapy - A general approach. In R.B. Haynes & F.H Leenen (Eds.), Down with high blood pressure (pp. 94-107). Toronto: Grosvenor House Press Inc.

Olson, R.P., & Kroon, J.S. (1987). Biobehavioral treatment of essential hypertension. In M.S. Schwartz (Ed.), Biofeedback: A practitioner's guide (pp. 316-339). New York: The Guilford Press.

Onrot, J., Wilson, T., & Dubois, M. (1990). Drugs and the sympathetic nervous system. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 117-125). Toronto: Grosvenor House Press Inc.

Pickering, T.G., & Gerin, W. (1990). Cardiovascular reactivity in the laboratory and the role of behavioral factors in hypertension: A critical review. Annals of Behavioral Therapy, 12, 3-16.

Roberts, A.H., Kewman, D.G., & MacDonald, H. (1973). Voluntary control of skin temperature: Unilateral changes using hypnosis and feedback. Journal of Abnormal Psychology, 82, 163-168.

Rose, G.D., & Carlson, J.G. (1987). The behavioral treatment of Raynaud's disease: A review. Biofeedback and Self-Regulation, 12, 257-272.

Roy, L.F., & Leenen, F.H. (1990a). Ace inhibitors. In R.B. Haynes & H.H. Leenen (Eds.), Down with high blood pressure (pp. 126-130). Toronto: Grosvenor House Press Inc.

Roy, L.F., & Leenen, F.H. (1990b). Calcium antagonists. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 131–135). Toronto: Grosvenor House Press Inc.

Roy, L.F., & Leenen, F.H. (1990c). Vasodilators. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 136–138). Toronto: Grosvenor House Press Inc.

Sackett, D.L. (1990). The benefits of treatment. In R.B. Haynes & F.H. Leenen (Eds.), Down with high blood pressure (pp. 49–55). Toronto: Grosvenor House Press Inc.

Schwartz, M.S. (Ed.). (1987). Biofeedback: A practitioner's guide. New York: The Guilford Press.

Smith, J.J., & Kampine, J.P. (1984). Circulatory Physiology. Baltimore: Williams & Wilkins.

Stambrook, M., Hamel, E.R., & Carter, S.A. (1988). Training to vasodilate in a cooling environment: A valid treatment for Raynaud's Phenomenon? Biofeedback and Self-Regulation, 13, 9–23.

Tursky, B., Papillo, J.F., & Friedman, R. (1982). The perception and discrimination of arterial pulsations: Implications for the behavioral treatment of hypertension. Journal of Psychosomatic Research, 26, 485-493.

Wadden, T.A., Luborsky, L., Greer, S., & Crits-Christoph, P. (1984). The behavioral treatment of essential hypertension: An update and comparison with pharmacological treatment. Clinical Psychology Review, 4, 403-429.

Waxman, D. (1989). Hartland's medical and dental hypnosis (3rd ed.). Toronto: Bailliere Tindall.

Weitzenhoffer, A.M., & Hilgard, E.R. (1959). Stanford hypnotic susceptibility scale: Forms a and b. Palo Alto: Consulting Psychologists Press, Inc.

Yamada, Y., Miya Jima, E., Tochikubo, O., Matsukawa, T., & Ishii, M. (1989). Age-related changes in muscle sympathetic nerve activity in essential hypertension. Hypertension, 13, 870-877.

Appendix A

Biofeedback Treatment Protocol

<u>The Autogenic Rag Doll</u>

Heaviness of the Limbs: Make yourself comfortable and allow your eyes to close. Then lift your left arm a little, and just let it drop. Let it drop heavily, as if it were the arm of a Raggedy Ann doll, one of those floppy dolls or animals. Choose one in your imagination. Choose a doll, an old beloved soft teddybear, a velveteen rabbit, a bean bag toy, or even a pillow or a blanket. Choose anything soft which you like. Lift your left arm again a little and drop it, and let it rest there a moment...

Now think of your left arm again, but don't lift it in reality, just in your imagination. Lift it in the imagination as you breathe in...and think that you are dropping it again, and do this while you breathe out. Let your left arm go limp like a rag doll while you breathe out...Feel free to move any part of your body to a more comfortable position any time you want to do so.

Next imagine that you put your rag doll into the sun. Let it be warmed by the sun. The giant rag doll is lying very relaxed. Feel how the sun is shining on it. Feel it on your left arm first...and then on your left hand. See to it that the head of the rag doll is in the shade and kept cool, but all the limbs are sprawled out in the sun. Feel your left arm, warm, heavy, and relaxed...And feel your left hand, warm, heavy, and relaxed...Remember, you are the giant rag doll, and you are lying in the sun; all your limbs are nice and warm, but your head is lying in the shade and is comfortably cool...Perhaps you can feel the warm sand between your fingers...you can sense that the temperature in your left hand and fingers is rising from the warmth of the sun and sand...From this sense of warmth your arteries are expanding to carry more of your normal, warm, healthy, blood into your left arm...and down into your left hand and fingers...as more of your warm blood flows into your left arm, you can feel your left hand becoming warmer, relaxed, and comfortable...the temperature in your fingers is rising...you feel calm, and are enjoying the heat of the sun and sand.

Now I want you to imagine that somebody has moved your rag doll and placed it in a big reclining chair, next to a fireplace. You are stretched out on this chair, feeling comfortable and relaxed...The fire is burning quietly and does not provide any type of distraction for you...You can feel the warmth of the fire as it heats the room to a comfortable temperature...since you are seated beside the fireplace, you notice the pleasant warmth on your left side of your body...and in particular I want you to focus on the sensations of warmth in your left arm...and down into your left hand and fingers. You can feel the temperature in your left hand and fingers rising as the relaxing warmth of the fire meets your skin...you feel pleasantly warm and relaxed, noticing how much more pleasant the left side of your body feels compared with your right side, which is farther away from the direct effects of the warm fire burning next to you.

Now I am going to ask you to use the remaining time of our session to try and increase the temperature in your left hand, using your own methods or continuing to use the examples that I have just provided for you. Feel free to open your eyes at any time so that you can observe your progress on the biofeedback machine's digital display.

Appendix B

Hypnosis Treatment Protocol

Eye Fixation with Progressive Relaxation

Lie back comfortably in the chair. Look at the spot on the ceiling, slightly behind you...and look upwards and backwards at it. Keep your eyes fixed on that spot on the ceiling. Let yourself go...limp and slack. Let all the muscles of your body relax completely. Breathe quietly...in...and out. Now I want you to concentrate upon your feet and ankles. Let them relax...let them go...limp and slack. And you will begin to note a feeling of heaviness in your feet. As though they are becoming just as heavy as lead. As if they are causing your legs to sink down into the foot rest of the chair. Keep your eyes fixed on that spot on the ceiling. And as you stare at it...you will find that your eyelids are becoming heavier and heavier...so that presently they will want to close. As soon as they feel they want to close...just let them close. Let yourself go completely. Let the muscles of your calves and thighs go quite limp and relaxed. Let them relax...let them go...limp and slack. And as they do so...your eyes are beginning to feel more and more tired. They may be becoming a bit watery or even dry. Soon, they will feel so heavy that they will want to close. As soon as they feel they want to close...just let them close...entirely on their own. Let the tension go completely.

Give yourself up totally to this very pleasant...relaxed...drowsy...comfortable feeling. Let your whole body go limp and slack...heavy as lead. Now, the muscles of your stomach...let them relax...let them go...limp and slack. Now, the muscles of your chest...and your back. Let them go...limp and slack...let them relax completely. And you can experience a feeling of heaviness in your body. As though your whole body is becoming just as heavy as lead. As if it is wanting to press down...deeper and deeper...into the chair. Just let your body go...heavy as lead. Let it sink back comfortably...deeper and deeper into the chair. And as it does so...your eyelids are feeling even heavier and heavier. So very, very heavy...that they are wanting to close. As soon as they feel they want to close...just let them close. And now, that feeling of relaxation is spreading into the muscles of your hands and arms, your shoulders and neck. Let your neck muscles relax...let them go...limp and slack. Allow them to relax completely. And as they do so...you will note a feeling of heaviness in your hands and arms. As though they are becoming just as heavy as lead. Let them go...heavy as lead. Let them relax completely. And the heaviness spreads pleasantly and comfortably through your neck and facial muscles to your eyes and eyelids. And as it does so...your eyelids are feeling very, very heavy...your eyes so very, very tired...that they are wanting to close. Wanting to close, now...closing... closing tighter and tighter. (Repeat until eyes close) Now I want you to allow yourself to feel like you are asleep, but in a dreamy state where you will continue to hear my voice.

Deepening by Arm Levitation

Let yourself relax completely...and breathe quietly...in...and out. And as you do so...you will gradually sink into a deeper, deeper dreamy state. And as you sink into this deeper, deeper dreamy state...I want you to concentrate upon the sensations you can feel in your left hand and arm. You will feel that your left hand is gradually becoming lighter and lighter. It feels just as though your wrist were tied to a balloon...as if it is gradually becoming pulled up...higher and higher...away from the chair. It is wanting to rise up...into the air...towards the ceiling. Let it rise...higher and higher. Just like a cork...floating on water. And, as it floats up...into the air...your whole body is feeling more and more relaxed...heavier and heavier...and you are slowly sinking into a deeper, deeper dreamy state. Your left hand is feeling even lighter and lighter. Rising up into the air...as if it were being pulled up towards the ceiling. Lighter and lighter...light as a feather. Breathe deeply...and let yourself relax completely. And as your hand feels lighter and lighter...and rises higher and higher into the air...your body is feeling heavier and heavier...and you are drifting into a deeper, deeper dreamy state. Now, your whole arm, from the shoulder to the wrist, is becoming lighter and lighter. It is leaving the chair...and floating upwards...into the air. Up it comes...into the air...higher and higher. Let it rise...higher and higher...higher and higher. It is slowly floating up...into the air...and as it does so...you are drifting into a deeper, deeper sleep-like dreamy state.

Deepening By Arm Heaviness

You have enjoyed feeling (or tried to experience) lightness in your arm, but now I want you to feel that your arm is becoming heavier and heavier again. Heavier and heavier...just like a lead weight. It is slowly sinking downwards...on to the chair again. Let it go...heavy as lead...let it sink down...further and further. And as it does so...you are falling into an even dreamier state than before. Deeper and deeper...deeper and deeper dreamy state. Your arm is feeling heavier and heavier...heavy as lead. It is sinking down, now...on to the chair. And as it does so...you are falling into a deeper, deeper dreamy state. The moment your arm touches the chair...you will be in a very, very deep dreamy state...deeper than you were before.

Blood Perfusion Imagery

Picture your strong normal blood...flowing from your strong, normal heart...through a system of canals into your left arm (leg)...and down into your left hand (foot)...calm and comfortable. These canals are your arteries and they are expanding to facilitate the increased flow...pleasurable sensations...blood rushing through your left arm (leg) and down into your left hand (foot)...you may already feel your left hand (foot) becoming warmer...comfortable...nothing to distract you now...enjoying the warmth and sensation of your healing blood flowing...your blood carrying all the building blocks of healing; protein, amino acids, vitamins...and you can see these canals in your left arm (leg) expanding as they carry more nourishing and warm blood down into your left hand (foot)...you are very relaxed and comfortable...you can feel the pleasant warmth in your left hand (foot) from your blood rushing into it, and because of this heavy, relaxed, dream-like state you are in, your heart is beating slower...and normal. Your blood pressure is also lower because of your heart beating slower...and this complete state of relaxation that your body is in...feeling warmth and heaviness throughout your body. (Repeat Blood Perfusion Imagery)

Blood Perfusion Posthypnotic Suggestion

This feeling of warmth and comfort in your left hand is something that I would like you to experience each day inbetween your visits here with me. Each day I would like you to watch television for at least one hour...what ever you watch is your choice...but whenever a commercial appears on the television you will picture your strong normal blood...flowing from your strong, normal heart...through the canals in your left arm (leg)...and down into your left hand (foot)...and you will feel calm and comfortable...your canals will expand to facilitate the increased flow...it will provide pleasurable sensations...blood rushing to your left hand (foot) during the commercial break...you will feel your left hand (foot) becoming warmer...comfortable...nothing will distract you...you will enjoy the warmth and sensation of your healing blood flowing throughout your left arm (leg) and hand (foot) while the commercial is on...these comfortable feelings of warmth and relaxation will occur each time you are watching t.v. and a commercial break appears. (Repeat these Posthypnotic suggestions)

Awakening the Subject

In a few moments...as I count backwards from 7 down to 1...

you will begin to arouse yourself and your eyes will open and be wide awake again. You will have no unpleasant after effects from this experience. You will wake up feeling wonderfully better for this deep, refreshing dreamy state. You will feel completely relaxed...both mentally and physically...quite calm and composed...without the slightest feeling of drowsiness or tiredness. And next time you visit me...you will not only be able to go into this sleep much more quickly and easily, because of your practising this technique...but you will also be able to relax much more deeply. Each time, in fact...your dreamy state will become deeper and deeper. After you are awake you will remain relaxed while I take a measurement of your heart rate and blood pressure, just like I have always done. Seven...six...five...four...three... two...one! Eyes open...wide awake!

Appendix C

Consent Form

"Reducing Heart Rate and Diastolic and Systolic Blood Pressure Using Nonpharmacological Methods in the Treatment of Essential Hypertension"

Investigators: Mr. Jon Pfaff
Dr. Charles Preston (supervisor)
Dr. George Fodor (supervisor)

You have been asked to participate in a research study. Participation in this study is entirely voluntary. You may decide not to participate or withdraw from the study at any time without affecting your normal treatment.

Confidentiality of information will be maintained by the investigator. The investigator will be available during the study at all times should you have any problems or questions.

Purpose of Study: Stress is believed to activate the sympathetic nervous system, which can cause the blood vessels in the extremities to narrow, the heart to beat faster, and blood pressure to rise. Using hypnosis or thermal biofeedback (a technique which measures changes in surface skin-temperature) may enhance blood flow to the extremities and reduce sympathetic nervous system activity. This may result in lowering of the blood pressure. This study seeks to evaluate this.

Procedures and Tests Subjects Will Undergo: Two weeks prior to the beginning of treatment all subjects will visit with the investigator in order to obtain a measurement of their heart rate, using an EKG machine. This procedure is completed by placing electrodes on the subject's forearms and lower legs. These are held in place with small rubber straps. The EKG machine then provides a printout of the subject's heart activity. Two measurements of heart rate will be taken during each of the four appointments in the two weeks prior to the treatment phase. Also during these visits, each subject will have their blood pressure measured twice by the investigator, while they are seated in a reclining chair. These procedures will be completed so that the investigator is aware of each subject's heart rate and blood pressure prior to the treatment phase of the study. All subjects will have these measures taken again at each treatment session so that the investigator can observe if any changes in heart rate and/or blood pressure have occurred due to the subject's participation in the study. During four-weekly visits after the treatment sessions have concluded, all subjects will undergo these same measurements so that the investigator may observe whether changes in blood pressure and/or heart rate following the treatment phase have lasting effects, or have returned to the levels observed before treatment. All subjects will also undergo the Stanford Hypnotic Susceptibility Scale-Form A, conducted by the investigator in the week prior to treatment, which consists of 12 items for examining how prone each subject is to hypnosis. Subjects will then be assigned to either a thermal biofeedback treatment group or a hypnosis treatment group for the initial four weeks of treatment. After these four weeks have been completed, all subjects will then be transferred into the opposite treatment group for the final four weeks of the therapy phase. Subjects in the biofeedback group will undergo 8 Skin-temperature biofeedback sessions, over a four week period, on an individual basis for approximately 45 minutes per session. The first 5 sessions will be based on teaching the subject how to increase the surface temperature of their hand (which will increase blood flow to this area of their body), while the final 3 sessions will concentrate on increasing the skin-temperature of the foot. Those subjects in the Hypnosis group will undergo 5 sessions focusing on increasing blood flow in the arms and hands using imagery while in the hypnotic state, and then 3 sessions concentrating on increased blood flow in the legs and feet. The hypnosis sessions will also take place over a four week treatment period on an individual basis, for approximately 45 minutes per session.

Duration of Subject Participation: Subject participation will be for a period of 14 weeks. Subjects will have two-45 min. sessions per week for eight weeks, in addition to the eight clinic visits over the 14 week period, for heart rate and blood pressure measures.

Foreseeable Risks, Discomforts, or Inconveniences for Subjects:
There should not be any foreseeable risks or discomforts for the subjects. Having to attend two treatment sessions a week, for eight weeks, may be an inconvenience for the subjects.

Benefits Subjects may Experience from Study: Subjects may have lower blood pressure and/or heart rate resulting in the reduction or elimination of their prescribed medications, or the need for medication in those subjects whose blood pressure is not currently controlled by drugs.

Alternative Treatments for Subjects not Entering Study: Continued contact with their physician and use of their present medications.

I, ____, the undersigned, agree to participation in the research study described above. Any questions have been answered and I understand what is involved in the study. I realize that participation is voluntary and that there is no guarantee that I will benefit from my involvement. I acknowledge that a copy of this form has been offered to me.

________________________________ ________________

(Signature of Participant) (Date)

____

(Signature of Witness)

To be signed by investigator:

To the best of my ability I have fully explained to the subject the nature of this research study. I have invited questions and provided answers. I believe that the subject fully understands the implications and voluntary nature of the study.

________________________________ ________________

(Signature of Investigator) (Date)

Phone Number: 754-4018