Relaxation in the treatment of essential hypertension
by Clinton Dale Chapman

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Psychology
Montana State University

Abstract:
Three relaxation techniques, biofeedback-aided relaxation, progressive relaxation and the relaxation response, were compared in their ability to reduce blood pressure in hypertensives. The subjects received twenty minutes of training per day, five days a week for two weeks. At the end of the training period all groups showed a significant reduction in blood pressure but no significant between group differences were found. The results continue to support the idea that blood pressure can be controlled by behavioral techniques. However more research to determine the relationship between skeletal muscle tone and the lowering of blood pressure needs to be done. Also the type of training sessions and learning paradigm that will produce the greatest reduction in blood pressure need to be examined further.

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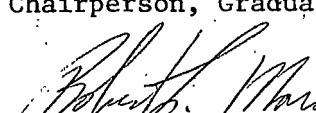

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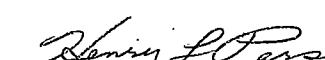

Graduate Dean

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ABSTRACT

Three relaxation techniques, biofeedback-aided relaxation, progressive relaxation and the relaxation response, were compared in their ability to reduce blood pressure in hypertensives. The subjects received twenty minutes of training per day, five days a week for two weeks. At the end of the training period all groups showed a significant reduction in blood pressure but no significant between group differences were found. The results continue to support the idea that blood pressure can be controlled by behavioral techniques. However more research to determine the relationship between skeletal muscle tone and the lowering of blood pressure needs to be done. Also the type of training sessions and learning paradigm that will produce the greatest reduction in blood pressure need to be examined further.

INTRODUCTION

About 20% of the adult population in the United States have hypertension, taking 160 mm Hg as the systolic and 95 mm Hg as the diastolic dividing line (National Health Survey, 1964; World Health Organization, 1959).

Ninety percent of the hypertension seen in the United States is diagnosed as essential hypertension (Laragh, 1963). The use of the term essential means that this type of hypertension does not have a known etiology. It is generally agreed that essential hypertension is a product of environmental factors and a hereditary predisposition (Abboud, 1976; Patel, 1977; Weiner, 1976). Environmental situations which require continuous behavioral and physical adjustments may be translated through the central nervous system into hemodynamic events such as increased cardiac output and increased peripheral resistance which contribute to essential hypertension (Folkow, Hallback, Lundgren, Sivertsson & Weiss, 1973; Gutmann, 1971; Henery, 1976). These environmental conditions may lead to essential hypertension by repeated or chronic arousal of the hypothalamic defense area which is associated with increased sympathetic nervous system activity (Cannon, 1914).

Currently the use of antihypertensive drugs is the most common treatment for hypertension (Moser & Goldman, 1967, pp. 154; Pickering, 1974, pp. 106). There is no ideal antihypertensive drug in that they all produce some form of deleterious side effect (Hirschman & Herfindal, 1976; Moser & Goldman, 1967, pp. 154; Pickering, 1974, pp. 106-113).

Other drawbacks to the use of antihypertensive drugs are the cost of the drugs and a lack of patient compliance to the drug regime (Langfeld, 1973; McKenny, Slining, Henderson, Devins & Burr, 1973). Because of the problems of treating hypertension with drugs and the suspected etiology of essential hypertension, behavioral approaches to the treatment of essential hypertension have been explored (Shapiro, A. P., Schwartz, Donald, Ferguson, Redmond, Stephen & Weiss, 1977).

A common element in these behavioral approaches is the induction of deep muscle relaxation which is usually accompanied by subjective reports of relaxation. For example, it has been subjectively reported in studies using the blood pressure biofeedback approach that relaxation accompanies decreased blood pressure (Shapiro, D., Tursky, Gershon & Stern, 1969; Shapiro, D., Schwartz & Tursky, 1972). Other behavioral approaches such as autogenic training, progressive relaxation, the relaxation response, and various forms of meditation, all incorporate relaxation into their techniques. Relaxation is a condition with specific biochemical and physical characteristics such as decreased heart rate, blood pressure, skeletal muscle tone, and sympathetic nervous system activity (Benson, Beary & Carol, 1974; Paul, 1969). Since decreased skeletal muscle tone is characteristic of a relaxed state the measuring of skeletal muscle tone with an electromyogram is assumed to be an appropriate method of determining the degree of relaxation a person is experiencing (Stoyva & Budzynski, 1974). The relaxation state has been referred to as an anti-stress response in that it opposes

the hypothalamic defense area activation seen during environmental stress. Relaxation has been used as an effective means to reduce anxiety (Goleman & Schwartz, 1976; Raskin, Johnson & Rondestvedt, 1973). Hence reducing anxiety through relaxation should work to reduce blood pressure by countering the physical reaction of a hypertensive to environmental stress. The relationship between blood pressure, relaxation and skeletal muscle tone is further supported by the work of Jacobson (1938) who showed that decreased muscle tone is not compatible with anxiety and by the more recent findings that decreased skeletal muscle tone is an effective means of lowering blood pressure (Datey, Deshmukh, Dalvi & Vinekar, 1969).

Even though it seems clear that behavioral approaches can produce reductions of blood pressure, it is not clear which methods are most effective. Typically, various behavioral approaches are combined, making it difficult to separate out critical variables and nonspecific or placebo effects. Also, they are difficult to compare due to the use of different methodologies concerning the measurement of blood pressure, length of training, and the setting of the experiment. The above mentioned factors were directly controlled in the present study by directly comparing three behavioral approaches for short term effectiveness in lowering blood pressure. By directly comparing these approaches, the length of training, method of measuring blood pressure and the experimental setting are held constant across all

approaches. Of the many behavioral approaches previously applied to the problem of essential hypertension, the three relaxation techniques of biofeedback-aided relaxation, progressive relaxation, and the relaxation response, were chosen because they all employ muscle relaxation as part of their technique and each has shown some success at producing relaxation followed by the reduction of blood pressure.

Biofeedback-aided relaxation is the feeding back of electromyographic information with tones or light which indicate the level of the skeletal muscle tone so that a person can learn to relax the skeletal muscles. As with other biofeedback procedures, biofeedback-aided relaxation gives a person more precise information about his physical state than he would be able to receive without the aid of a feedback apparatus. Learning to relax skeletal muscles with the aid of a feedback apparatus is a form of active learning in that the person is processing information received from the apparatus to assist him in relaxing. Biofeedback of electromyographic information from the frontalis muscle has been shown to produce a low arousal condition characteristic of a relaxed state (Raskin, et al., 1973; Stoyva & Budzynski, 1974).

The progressive relaxation technique is widely used and relies on relaxing skeletal muscles to induce relaxation (Jacobson, 1938). With the progressive relaxation technique a person learns to relax his muscles by alternately tensing and relaxing major muscle groups. The person becomes aware of the difference in levels of tension in his

muscles and thereby learns to reduce the tension. The progressive relaxation technique is an active form of learning in that the person is actively processing information about the level of tension in his muscles. But unlike the biofeedback-aided relaxation technique a feedback apparatus and it's concomitant precise information on muscle tension is not available to aid the learning process. Variations of this technique have been successful in lowering the blood pressure of hypertensives (Grahman, Beiman & Ciminero, 1977; Shoemaker & Tasto, 1975; Taylor, Farguhar, Nelson & Agrus, 1977).

The relaxation response is a technique of relaxation which incorporates the underlying principles of different forms of meditation without the religious overtones (Benson, et al., 1974). The four basic elements of the relaxation response technique are: a mental device, a passive attitude, decreased muscle tension, and a quiet environment. The mental device is a constant stimulus such as a sound or a word repeated silently for the purpose of shifting away from logical, externally-oriented thought. A passive attitude is maintained in that the person should not worry about how well he is performing the technique. The person should be in a comfortable position to decrease muscle tone and in a quiet environment to decrease the number of distracting environmental stimuli. The relaxation response technique is a form of passive learning in that presumably no information concerning the state of relaxation is being actively processed.

Meditation has proven to be effective in lowering the blood pressure of hypertensives (Benson, Rosener, Marzetta & Klemchuk, 1974; Blackwell, Bloomfield, Gartside, Robinson, Haneson, Magenhenhein, Nidich & Ziegler, 1976). The use of the relaxation response technique which has no religious overtones has also resulted in the reduction of the blood pressure of hypertensives (Benson, 1977).

In the present study the three above described relaxation techniques were compared in their ability to produce relaxation measured via the electromyogram from the frontalis muscle and decrease blood pressure in hypertensives. From previous research it was expected that all of these relaxation techniques would be able to induce relaxation and lower blood pressure to some degree. It was also expected that the biofeedback-aided relaxation technique would be the most effective in lowering blood pressure followed next by the progressive relaxation technique and then the relaxation response technique. The biofeedback-aided relaxation technique was expected to be most effective because it supplies the largest amount of information concerning the state of relaxation via the use of a feedback apparatus. The progressive relaxation technique would be the next most effective because it supplies the next largest or most precise amount of information concerning the relaxation state in that this technique teaches a person to be aware of the amount of tension in his muscles. The relaxation response technique is expected to be the least effective

in lowering blood pressure because it supplies little or no systematic information concerning the state of relaxation in that the person is specifically instructed not to pay direct attention to his state of relaxation.

Method

Subjects

The subjects were eight male and seven female hypertensives from the community who volunteered for the experiment in response to a radio announcement.

Apparatus

A standard aneroid syphgmomanometer was used to measure the blood pressure. An Autogenic 1700 feedback myograph was used to provide feedback and measure electromyographic information.

Procedure

The blood pressure of all subjects was taken three times during a half-hour period each day for three consecutive days. The subjects were divided into three age, blood pressure and sex matched groups by equating the means and standard deviation for each group. The groups consisted of biofeedback-aided relaxation, progressive relaxation, and the relaxation response. Each of the groups received half-hour training sessions five days a week for two weeks. Electromyographic readings were continually monitored from the frontalis muscles in all subjects during the training sessions.

During the first training session all subjects received written information on the relationship between high blood pressure and relaxation. The biofeedback-aided relaxation group received electromyographic feedback from the frontalis muscle using continuous auditory and visual feedback. The biofeedback-aided response group used all of the sessions to practice lowering the muscle tension of the frontalis muscle.

The progressive relaxation group learned to relax major muscle groups using the method described by Wolpe (1969, pp. 100-107). Instructions were received from a tape recording over headphones during the first half of each session. The second half of the session was used for practicing the technique.

The relaxation response group received relaxation training based on meditation which included a mental device, a passive attitude, decreased muscle tone and a quiet environment as described by Beary, Benson and Klemchuk (1974).

After the training sessions the blood pressure of the subjects was taken as described previously. During this post-training measurement the subjects were told not to practice any relaxation techniques they had learned.

Results

The pre and post blood pressure values were analyzed with an rBC nested analysis of variance model with r being five subjects per

group, B being the three treatment groups, and C being the pre and post treatment conditions. Systolic and diastolic blood pressure values were treated as separate dependent variables.

Table 1 shows the mean pre and post treatment blood pressure for both the systolic and diastolic readings in each group.

Table 1

Mean Systolic and Diastolic Measurements Before and After Treatment for All Groups

Group	BR	PR	RR
Systolic			
Pre	158.0	162.6	154.2
Post	149.4	155.8	138.8
Diastolic			
Pre	91.8	96.2	94.6
Post	89.4	90.4	88.6

No significant differences were found between the three groups in either systolic or diastolic blood pressures, $F\ (2,12) = 1.32$, $p > .05$; $F\ (2,12) < 1.0$, respectively.

There was a significant difference between pre and post treatment blood pressures for both systolic and diastolic readings. $F\ (1,12) = 47.79$, $p < .001$; $F\ (1,12) = 28.81$, $p < .001$, respectively.

A Scheffé multiple comparisons test was used for comparing pre versus post conditions for each group. A Scheffé F of 4.17 was calculated at the .05 α-level for the treatment effect.

Table 2 gives the F values determined with a one-way analysis of variance for the treatment effect of each group.

Table 2

F Values of One-Way Analysis of Variance For Pre and Post Blood Pressure Measurments

Group	BR	PR	RR
Systolic	1.992	0.414	6.131
Diastolic	0.135	1.602	2.624

The mean electromyographic values for each group were: BR = 2.67, PR = 2.51, RR = 2.29.

There was no significant differences between the groups in electromyographic levels obtained during training, $F(2,12) < 1.0$.

Discussion

In agreement with previous research, there was no significant between group differences found. All three of these techniques incorporate decreased skeletal muscle tone to achieve their relaxing effect. This was monitored in the present study by taking

electromyographic data which indicated that all of the groups were able to achieve a low level of skeletal muscle tone which is indicative of a relaxed state. Skeletal muscle tone is but one of many physiological variables which change when a relaxed state is achieved. The other changes that are typically seen are decreased oxygen consumption, carbon dioxide elimination, heart rate, minute ventilation, and arterial blood lactate (Benson, et al., 1974). Skeletal muscle tone is assumed to be an important factor in achieving a relaxed state because it is under voluntary control. However, more research needs to be done to determine the precise nature of the relationship between skeletal muscle tone and sympathetic nervous system activity. It may be that learning to control skeletal muscle tone is an effective means of controlling sympathetic arousal and can thereby be used to avert the deleterious effects of repeated stresses on the cardiovascular system. Sympathetic nervous system activity should be studied within the context of behavioral approaches to hypertension such as those used in the present study in order to determine which approaches achieve the lowest level of activity.

Also in agreement with previous research, a significant pre-post treatment effect was found. Previous research using these techniques have reported reductions in blood pressure of 10-25 mm Hg systolic and 5-15 mm Hg diastolic. The reductions in blood pressure

of 6.8-15.4 mm Hg systolic and 2.4-6.0 mm Hg diastolic found in this study are similar to those found in other studies. The blood pressure reductions seen in this study, although statistically significant, are only biologically modest reductions in blood pressure. Larger reductions in blood pressure may be achieved with longer training sessions or different training schedules. For example, it may be more effective to conduct the training sessions only twice a week for several months.

Results of the Schéffe multiple comparison test indicate that the relaxation response group had the strongest input into the treatment effect. The relaxation response group does not employ a biofeedback apparatus to aid learning and the subject maintains a passive role towards the learning process. Since the relaxation response technique supplied the least amount of information about the relaxation state it was expected that this technique would be the least effective at lowering blood pressure. The relaxation response may have had the strongest effect because of an antagonistic effect of the feedback apparatus. That is, the tone and lights used for feedback may, in fact, interfer with the relaxation process. Studies could be done to determine the effect of interference such as apparatus feedback and having to actively process muscle tension information on the ability to relax.

In summary this study shows that relaxation techniques are able

to produce modest reductions in the blood pressures of essential hypertensives. However, a more important question than how much the blood pressure can be reduced is what length of time will the blood pressure remain lowered. Lowering of blood pressure can only benefit the hypertensives if it remains down. There have been only a few reports of follow up studies being done and generally the decreases in blood pressure seen initially do not remain. Thus relaxation techniques which can be readily incorporated into the lifestyle of the hypertensive need to be developed. Perhaps Wolpe's systematic desentization (1969) technique or other psychotherapy procedures could be used in conjunction with relaxation techniques to produce lifestyle changes that would result in permanent blood pressure reductions.

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