

## Biofeedback Assisted Relaxation in Essential Hypertension : Short Term Follow-up of Contributing Effects to Pharmacotherapy on Blood Pressure and Heart Rate "Brief Communication"

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*The present study was designed to evaluate the possible beneficial effects of biofeedback-assisted relaxation to pharmacotherapy on blood pressure and heart rate in patients with essential hypertension. Twenty patients with essential hypertension and without any complications or end-organ damage participated in the study. All the patients were using anti-hypertensive drugs. The study protocol consisted of an interview, 10 days baseline, 10 biofeedback-assisted relaxation sessions and a 10-day post-treatment period. Interview blood pressure (BP) and heart rate (HR) measurements, baseline mean values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and HR recorded during the 1st, 10th and 20th minutes of each session and the post-treatment mean values were evaluated. Significant differences were found between the mean values of SBP, DBP and HR after the whole treatment protocol (Wilcoxon signed-ranks test). The mean values of SBP, DBP and HR measurements recorded during the 1st, 10th and 20th minutes of the biofeedback-assisted relaxation sessions, which were evaluated by repeated measures of ANOVA on ranks test, showed a significant decrease only for the 10th minute values at the end of the whole treatment program. Despite a short follow-up, it was suggested that these results were encouraging considering the fact that once the patients are thoroughly instructed in home practice of relaxation and encouraged to develop their own strategies for relaxation, the long term outcome may also be promising.*

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**Key Words:** Biofeedback, essential hypertension

Biofeedback may be defined as a tool that involves measuring and displaying ordinarily unfelt

physiological events in order to permit self-regulation of those events (Krebs, 1990). Biofeedback-assisted relaxation therapy has been found useful in controlling blood pressure in mild hypertensives and/or as an adjunct to pharmacotherapy in patients with moderate essential hypertension (Patel and North, 1975; Patel *et al.* 1981; Blanchard *et al.* 1986; Mc Grady and Higgins, 1989). Glasgow and associates (Glasgow *et al.* 1982) reported that over the short term, relaxation and biofeedback were

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equally effective in lowering blood pressure, whereas over the long term, a combination of biofeedback and relaxation was better than each used by itself.

## MATERIALS AND METHODS

### Patients

Eighteen female and 2 male patients participated in this study designed to investigate the contributing effects of biofeedback-assisted relaxation to pharmacotherapy on blood pressure and heart rate in essential hypertension. Their average age was 54.7 years (range 40-72). Patients with essential hypertension without any complications, any other serious disorders or end-organ damage were selected for the study. All the patients were using anti-hypertensive drugs and, as the primary concern was to determine the possible contributing effects of biofeedback on conventional treatment protocols (ie. various medications), they were advised to continue their medication. The patients were using either *Enalapril* (20 or 40 mg tablet one per day) or *Amlodipine* (5 or 10 mg tablet per day) alone or in combinations of the two drugs if warranted. The duration of follow-up under medication varied between one and five years.

### Procedure

The study protocol consisted of an interview, 10 days baseline, 10 biofeedback-assisted relaxation sessions and a 10-day post-treatment period. During the interview, the initial blood pressure and heart rate values were recorded and the procedure was explained to the patients. During baseline, the patients were instructed in having their blood pressure and heart rate measured by a medical staff two times everyday (morning and evening) approximately during the same hours, and recording the results for 10 days before the biofeedback-assisted relaxation program. In each instance the patients were told they would have their blood pressure and heart rate measured two times with a 5-minute resting period in between. The reported levels represented the average of these two measurements.

### Treatment

After 10 days baseline, biofeedback-assisted relaxation treatment was applied to the patients for 10 sessions in the hospital. The treatment package consisted of both biofeedback and relaxation components and the patients were instructed in the practice of autogenic training and progressive relaxation by the physiotherapist. They were also encouraged to develop their own strategies, both during and after the whole protocol.

All sessions began with the subject seated in a recliner for an initial 20 minutes of resting and adaptation period in an empty and quiet room. After this period, the electrodes were attached for 20 minutes and the blood pressure and heart rate measurements were taken (always from the right arm) during the 1st, 10th and 20th minutes of the session. The measures were taken twice in succession and the average of these recordings was used for data analysis.

The biofeedback instrument used in this study (ZEN Trainer) was a galvanic skin response biofeedback unit. The specifications of the unit were:

- Electric current : DC 55  $\mu$ A max

#### *Stimulator unit*

- Sound frequency : 3Khz - 0Hz
- Pulse rate : 8Hz
- Output voltage : Max 60 V (1 Kohm load)
- Pulse width : Square pulse, 0.5 ms  $\pm$  0.05 ms  
Spike pulse, 0.1 ms - 0.5 ms

During the treatment session, the patients were instructed in autogenic relaxation and advised to practise every day at home for 20 minutes. Also they were encouraged to develop their own strategies for relaxation.

### Post-treatment period

The Post-treatment interval consisted of a 10-day period during which the same procedure explained in the baseline period continued.

**Table 1. Comparison of morning and evening mean values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) before and after the treatment**

	Pre-treatment		Post-treatment		t	p
	Mean	SD	Mean	SD		
Morning SBP (mmHg)	139.4	14.7	131.2	11.3	3.85	.001*
Evening SBP (mmHg)	139.2	13.6	132.1	10.3	3.49	.002*
Morning DBP (mmHg)	88.3	8.2	81.8	7.8	5.54	.000*
Evening DBP (mmHg)	87.4	8.4	82.0	7.5	3.79	.001*
Morning HR (/min)	75.8	7.1	71.5	5.6	3.80	.001*
Evening HR (/min)	75.8	6.7	70.9	5.24	3.96	.000*

\* : Significant (*Wilcoxon signed-ranks test*)

### Analysis of data

Interview blood pressure and heart rate measurements, baseline mean values of SBP, DBP and HR recorded during the 1st, 10th and 20th minutes of all sessions and post-treatment mean values were collected. *Wilcoxon signed-ranks test* was used to evaluate the differences between the mean values of SBP, DBP and HR (obtained both in the morning and the evening) before and after the whole protocol. The mean values of SBP, DBP and HR recorded during the 1st, 10th and 20th minutes of the session were compared with *Friedman repeated measures of ANOVA on ranks test* since the data were far from the normal distribution (Dawson and Trapp, 1990).

## RESULTS

Significant differences were observed between the mean values of SBP, DBP and HR measured in the morning compared to baseline. The values decreased from 139.4 mmHg to 131.2 mmHg ( $p=0.001$ ), from 88.3 mmHg to 81.8 mmHg ( $p=0.000$ ) and from 75.8/min to 71.5/min ( $p<0.001$ ) respectively after the treatment program (Table 1). The differences between the mean values recorded in the evening also proved to be significant after the treatment. Changes between these values, also presented in Table 1, were as follows: SBP from 139.2 mmHg to 132.1 mmHg ( $p=0.002$ ), DBP from 87.4 mmHg

**Table 2. Comparison of the mean values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) in 1. 10. 20. minutes of biofeedback-assisted relaxation session after the whole protocol**

	Mean	SD	p
<b>SBP</b>			
1. Minute	138.4	13.9	
10. Minutes	125.4	12.4	.000*
20. Minutes	123.6	13.0	
<b>DBP</b>			
1. Minute	82.2	7.7	
10. Minutes	76.3	8.0	.000*
20. Minutes	74.8	9.0	
<b>HR</b>			
1. Minute	71.1	6.2	
10. Minutes	67.5	5.4	.000*
20. Minutes	66.0	5.1	

\* : Significant (*Friedman repeated measures ANOVA on ranks test*)

Multiple comparison test: *Student-Newman-Keuls method*

to 82.0 mmHg ( $p=0.001$ ) and HR from 75.8/min to 70.9/min ( $p<0.001$ ).

The mean values of SBP, DBP and HR measurements recorded during the 1st, 10th and 20th minutes of the biofeedback-assisted relaxation session which were evaluated by *Friedman repeated measures of ANOVA on ranks test* showed a significant decrease for the 10th minute values only at the end of the whole treatment program ( $p<0.001$ ) (Table 2).

Compared with the initial interview recordings,

the mean difference in SBP after our 30-day protocol was  $7.64 \pm 8.12$  mmHg considering the whole patient group. This value was  $5.95 \pm 5.2$  mmHg for DBP.

Finally, the number of patients who succeeded in lowering their SBP between 0-10 mmHg was 10, and 6 lowered their SBP more than 11 mmHg. Four patients failed to lower these values. On the other hand, 7 patients lowered their DBP between 0-5 mmHg, and 10 lowered their DBP more than 5 mmHg. Three patients failed to lower their DBP.

## DISCUSSION

Our primary concern in this study was to investigate the possible beneficial effects of biofeedback-assisted relaxation in patients with essential hypertension without any complications or end-organ damage. All the patients included were under medication since the aim was to determine if this mode of treatment has any contributing effect to pharmacotherapy in controlling blood pressure, and especially in dose adjustments of drugs which in the long term may result in various side effects. Although successful control of essential hypertension is often possible with pharmacotherapy, cumulative side effects and/or ineffectiveness due to a lack of patient compliance may necessitate other strategies (Fahrion *et al.* 1986). According to the results of many studies in this field, biofeedback-assisted relaxation may be suggested to provide the desired effect of reducing drug doses and the risks of end-organ damage which may occur in the long term, even in moderate hypertensives (Fahrion *et al.* 1986; Mc Grady *et al.* 1986; McCoy *et al.* 1988; Blanchard, 1990; Buby *et al.* 1990; Musso *et al.* 1991).

Reports suggesting the use of biobehavioral approaches such as biofeedback and relaxation as a substitute for drug therapy in essential hypertension are very limited in number due to the possible risk factors and the difficulty of long term study designs which could permit monitoring of patients without drug administration. On the other hand, biofeedback-assisted relaxation has been reported to be useful in controlling blood pressure as an adjunct to pharma-

cotherapy in moderate essential hypertension (Patel and North, 1975; Patel *et al.* 1981; Blanchard *et al.* 1986; Mc Grady and Higgins, 1989).

Fahrion (Fahrion *et al.* 1986) suggested that the development of biobehavioral treatment techniques for essential hypertension is a current health science priority and there is a need to reduce cardiovascular risk in a majority of patients while minimizing the risks of chemotherapy. The significant decrease in heart rate in addition to reduced systolic and diastolic blood pressures in the present study should be evaluated from this point of view since the studies regarding the beneficial effects of biofeedback-assisted relaxation on heart rate are very scarce in the literature.

Biobehavioral approaches to the treatment of essential hypertension include biofeedback training, relaxation procedures, hypnosis, psychotherapy, environmental manipulation (such as hospitalization) and placebo techniques. Many studies have shown that patients with essential hypertension can learn to lower their blood pressure with the assistance of biofeedback (Kristt and Engel, 1975; Mc Grady *et al.* 1981; Fahrion *et al.* 1986). Most of the authors interested in biofeedback treatment used a multicomponent method which consists of (1) feedback of physiologic indices such as peripheral temperature and muscle tension levels, (2) non-biofeedback relaxation techniques such as progressive relaxation and autogenic exercises, (3) home monitoring of blood pressure and (4) home practise of relaxation (Blanchard *et al.* 1986; Fahrion *et al.* 1986).

In the 10-day post-treatment period of our protocol, a significant portion of the patient group learned appropriate relaxation techniques and did lower their blood pressures and heart rates. Despite a short follow-up, these results are encouraging considering the fact that once the patients are thoroughly instructed in home practise of relaxation and are encouraged to develop their own strategies for relaxation, the long term outcome may also be expected to be promising. The study is being carried on to investigate if a sustained decrease in these values will allow for the reduction of anti-hypertensive drug doses which, when chronically used, cause cumulative side effects or may be ineffective due to poor patient compliance.

## REFERENCES

- Blanchard EB: Biofeedback treatments of essential hypertension. *Biofeedback Self-Regul* 15: 209-227, 1990
- Blanchard EB, McCoy GC, Musso A, Gerardi MA, Pallmeyer TP, Gerardi RJ, Cotch PA, Siracusa K, Andrasik F: A controlled comparison of thermal biofeedback and relaxation training in the treatment of essential hypertension. I. Short-term and long term outcome. *Behav Ther* 17: 563-579, 1986
- Buby C, Elfner LF, May JG Jr: Relaxation pretraining, pulse wave velocity and thermal biofeedback in the treatment of essential hypertension. *Int J Psychophysiol* 9: 225-230, 1990
- Dawson B, Trapp RG: Comparing Three or More Means. *Basic and Clinical Biostatistics*, International ed. *Appleton & Lange*, 1990, 124-141
- Fahrion S, Norris P, Green A, Green E, Snarr C: Biobehavioral treatment of essential hypertension: A group outcome study. *Biofeedback Self-Regul* 11: 257-277, 1986
- Glasgow MS, Gaarder KR, Engel BT: Behavioral treatment of high blood pressure. II. Acute and sustained effects of relaxation and systolic blood pressure biofeedback. *Psychosom Med* 44: 155-170, 1982
- Krebs DE: *Biofeedback in Therapeutic Exercise*. In Basmajian J, Wolf S, eds. *Therapeutic Exercise*, 5th ed. *Williams & Wilkins Comp.*, 1990, 109-124
- Kristt DA, Engel BT: Learned control of blood pressure in patients with high blood pressure. *Circulation* 51: 370-378, 1975
- McCoy GC, Fein S, Blanchard E, Wittrock DA, McCaffrey RJ, Pangburn L: End organ changes associated with the self-regulatory treatment of mild essential hypertension. *Biofeedback Self-Regul* 13: 39-46, 1988
- McGrady A, Higgins JT: Prediction of response to biofeedback-assisted relaxation in hypertensives: Development of a Hypertensive Predictor Profile (HYPP). *Psychosom Med* 51: 277-284, 1989
- McGrady A, Utz SW, Woerner M, Bernal GA, Higgins JT: Predictors of success in hypertensives treated with biofeedback-assisted relaxation. *Biofeedback Self-Regul* 11: 95-103, 1986
- McGrady A, Yonker R, Tan SY, Fine TH, Woerner M: The effect of biofeedback-assisted relaxation training on blood pressure and elected biochemic parameters in patients with essential hypertension. *Biofeedback Self-Regul* 6: 343-352, 1981
- Musso A, Blanchard EB, McCoy GC: Evaluation of thermal biofeedback treatment of hypertension using 24-hour ambulatory blood pressure monitoring. *Behav Res Ther* 29: 469-487, 1991
- Patel C, Marmot MG, Terry DJ: Controlled trial of biofeedback-aided behavioural methods in reducing mild hypertension. *Br Med J* 282: 2005-2008, 1981
- Patel CH, North WRS: Randomized controlled trial of yoga and biofeedback in management of hypertension. *Lancet* 2: 93-95, 1975