Brief Report:

Regular Isometric Handgrip Training Lowers and Controls Blood Pressure in Hypertensive Patients; 4 One Year Cases

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Abstract

Background

Isometric exercise has been proposed as a treatment for hypertension in the elderly. Prior studies employed structured yet unmeasured levels of isometric activity. The current study utilized a measured amount of isometric handgrip activity to determine if this type of therapy could be a useful antihypertensive tool in a family practice setting.

Methods

Patients were recruited from within a single family practice. Isometric training was performed in the office 3 days a week, for one year. The handgrip protocol consisted of a determination of maximum handgrip strength and then 4 repetitions of a 45 second submaximal isometric holding period, with one minute rests.

Results

Four patients completed the entire year of the protocol. Blood pressures dropped in each of these four cases by 29/20, 36/18, 19/12, and 39/14 (SBP mmHg/DBP mmHg). Most of this drop was seen in the first 5 to 10 weeks, with maintenance thereafter.

Conclusions

Regular isometric handgrip training can be a useful tool in the treatment of hypertension in a family practice environment.

Key words:

Exercise therapy; hypertension; isometric contraction; family practice

Introduction

Isometric exercise has been proposed as a treatment for hypertension in the elderly (1). Blood pressure reductions have been seen using full body isometric efforts with structured but unmeasured levels of isometric activity. Recent work by Wiley et al.(2) has shown that a particular type of structured and measurable isometric effort is useful in reducing blood pressures in high-normal individuals. This type of training has potential as a therapeutic intervention for hypertensive patients. Unlike the earlier study of unmeasured isometric involvement, this new and novel hand-grip training regimen can be limited so as to maintain a confidence of safety; a serious lacking in the earlier methods employing sustained maximal efforts. Further, since the levels of effort are measured, we now have a quantitative method to measure compliance with the prescription of the training.

Following the recommendations of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VI) (3), lifestyle modifications are to be encouraged at all stages of intervention in hypertension. The current exercise recommendations are the standard of "regular aerobic physical activity - adequate to achieve at least a moderate level of physical fitness..." This says nothing of isometric training, but, as of yet, there have not been any large intervention trials of controlled isometric training for this purpose. Only recently has it been recognized that an acute isometric effort produces a cardiovascular recruitment of the nitric oxide synthase system of the endothelium (4); the key to blood flow and pressure control.

The opportunity to use moderately intense isometric training to achieve blood pressure control could be yet another form of lifestyle intervention, properly implemented to assure safety, for hypertensive individuals. The current study utilized this new method for isometric training to test its viability of use in definite hypertensive individuals to lower blood pressure in a family practice environment.

Methods

Patient recruitment: Patients of a family physician in a western South Carolina city, with documented hypertension, were invited to participate in an investigation of the influence of regular isometric training on blood pressure over an extended period of time. Informed consent was obtained from the patients to participate in the program and to have anonymous public presentation of data made.

Measurements: Blood pressure was measured by the physician or nurse using the standard auscultatory technique with a mercury sphygmomanometer and stethoscope. Baseline blood pressures were measured on two different days within one week of beginning the exercise protocol. Each day seated blood pressure was measured two times after the patient had rested at least five minutes. For expressing the pattern of blood pressure responses over the weeks, blood pressure measurements within a given week were averaged. Thus, if a patient visited the clinic 3 times within a week, 6 pressure measurements were averaged for that week's data point.

Isometric Training:

A handgrip dynamometer (CardioGrip alpha, MD Systems, Inc, Westerville, Ohio) was used to guide the patients in the performance of the isometric efforts. Patients established their Maximum Voluntary Contraction (MVC) by applying a maximal effort lasting no more than 2 seconds. After a 2 minute resting period, the first of four 45 second efforts at 50% of the MVC was begun. The dynamometer provided a means to set the display range appropriately, such that center of the range corresponded to one half of their MVC. The

patient was instructed to maintain the display needle on the dynamometer at the center mark of the display until instructed to release. Timing was accomplished by the nurse using a stopwatch. Arms were alternated, with 1 minute rests between, for a total of four 45 second efforts. This constituted the isometric exercise training session for a day.

Safety:

Contrary to the common caution against isometric load holding, recent reports have shown controlled isometrics to be well tolerated over a wide range of patient profiles (5). Specifically, no reports of deaths were found in the literature due to isometric stress, compared to a 2.4% mortality rate in 10,000 treadmill tests. Isometric exercise produces increased coronary blood flow, proportionately more than oxygen consumption.

Results

Case 1: Figure 1 shows the effect of isometric exercise training on a 73 year old Caucasian female. Her medical history included glaucoma in the 1970's; a cerebrovascular accident in 1991; labile blood pressure since the mid-1980's; a diagnosis of definite hypertension in 1992; and osteoarthritis. At the time of entry into the study her average blood pressure measured on 2 separate days was 151/90 and her ongoing medications were; the non-steroidal anti-inflammatory naproxen, the alpha 1-selective adrenoreceptor blocking agent terazosin HCl, a cholesterol-lowering agent, simvastatin, and the antihypertensive/diuretic indoline indapamide. This patient's average attendance over a 58 week period was 2.4 visits per week.

Following the dramatic decline in both systolic and diastolic blood pressures in the first four weeks, her dosage of terazosin was reduced from 5 to 2.5 mg daily. Although multiple other factors could have influenced blood pressure over ensuing weeks, it is interesting to note that her mean weekly blood pressures seemed to rise moderately, then decline over the following weeks (wk 8-20) as the isometric exercise training continued. This occurred, even though the terazosin was completely withdrawn at the end of week 6.

This patient broke her ankle on Monday of week 38, resulting in missing 6 consecutive visits for exercise training in weeks 38 and 39. Due to the reason for the absences, she was not withdrawn from the study. This is associated with a rise in blood pressure. Comparing her average pressures in week 40 with week 37, her SBP/DBP pressures

increased 11.7/4.3 mmHg. In week 58, the last week for this report, her pressures were 122/70, a decline from entry into the program of 29/20 mmHg SBP/DBP.

Case 2: This 48 year old Caucasian male entered the program with a resting blood pressure of 169/102 in the week prior to beginning the isometric training. He had a history of asthma and work-related stress. His medications at entry were; beclomethasone diproprionate, an anti-inflammatory steroid; a beta2-adrenergic bronchodilator; albuterol sulfate inhaler; a histamine H2-receptor antagonist, ranitidine HCl; and metoclopramide for gastrointestinal motility stimulation, but no medication for hypertension.

This patient had been using the albuterol inhaler with 2 inhalations every 4 hours. His blood pressure profile over the course of his involvement in the program is shown in Fig. 2. At week 10 he was instructed to use the inhaler p.r.n. At week 42 he experienced acute asthma and bronchitis. He was instructed to return to 2 inhalations, 4 times a day and was prescribed the synthetic antibacterial combination trimethoprim and sulfamethoxazole, which was continued through week 46. At week 52, this patient lost his job.

This patient also showed a rapid decline in blood pressure over the first few weeks on the isometric therapy. His overall attendance for the 73 weeks he was in the study was consistent, and averaged 2.6 visits per week. The week to week fluctuations in blood pressure were mostly within the normal range. Wider fluctuations ranged modestly higher, remaining well below the hypertensive level he was experiencing upon entering the study, and could well be related to other medical and emotional experiences in his

life. From the beginning to the end of his participation in the study his pressures declined by 36/18 mmHg.

Case 3: This 43 year old Caucasian male entered the program at 5' 10" and 209 pounds, on the calcium ion influx antagonist nifedipine, with an average resting blood pressure of 139/98 mmHg. Throughout his participation, he averaged performing the isometric therapy at the physician's office 2.4 times per week. At week 19 his physician stopped his nifedipine and started him on a non-selective beta-adrenergic blocking agent, propranolol. At week 26 the propranolol was stopped. At week 45 he reached the decision to change jobs.

Although his initial SBP was at the borderline level, apparently controlled to that level by his medication, a steady decline in both SBP and DBP was seen over several weeks, with modest fluctuations. At the time his blood pressure medication was withdrawn, week 26 his BP was at a very desirable level. The very apparent spike in pressure at week 44 seems associated with the events leading to and making the decision to change jobs.

His final week average pressures were 121/87, which were below his initial entry pressures by 19/12 mmHg. With his new job he chose to withdraw from active participation by visits to the physician's office and instead perform non-supervised isometric activity on a non-calibrated device on his own.

Even though this patient had a systolic pressure controlled with medication at about the borderline hypertensive level at the time of beginning the isometric exercise, the regular training seemed to provide additional benefit. The diastolic pressure was also lowered desirably over several weeks. It is quite apparent that, while the isometric therapy can provide a beneficial effect, stress situations can still produce at least transient elevations in blood pressure. It is unfortunate that this patient could not have been followed for a longer time after being in what was likely a less stressful job situation.

Case 4: Figure 4 shows the blood pressure response to the isometric therapy for a 69 year old male Caucasian. His height was 6'0" and weight was 178 pounds and he entered the program with an average blood pressure of 158/93 mmHg. He was taking 3.5 mg per day clonazepam for extreme agitation, and the antidepressant paroxetine HCl. He had a continuing history of severe grief from loss of his spouse 11 months earlier. His average attendance over the 73 weeks in the study was 2.8 visits per week.

A very dramatic decline in blood pressure of about 50 mmHg SBP and nearly 30 mmHg DBP occurred over the first 20 weeks in the training program. Some indication of a rebound from this low BP seemed to be occurring when, in week 30, a hernia was found. His BP stabilized at a very desirable level, with modest fluctuations, but not exceeding SBP of 130 nor DBP of 85 mmHg through week 73.

Discussion

This is the first study to use controlled isometric handgrip training to lower blood pressure in hypertensive patients. It was seen to be effective in reducing blood pressures over a 4 to 5 week period, and then maintain these lower levels with continued training, for a period of up to one year. With these results, it appears that this new therapy can be used as an adjunct to common interventions, and provide additional benefits to the patient.

One limitation of this study was the requirement for the patients to attend the therapy sessions at the clinic. While this did allow for ample blood pressure recordings, it limited the number of patients willing to participate. In future trials, the now available portable and recording CardioGrip RPT device could be sent home with each patient to remove the obstacle of travel and time. The patient would then only need to come to the clinic for blood pressure recordings. Compliance with the therapy could be assured by downloading the archive data inside of the device.

Another limitation was in the design of this study. It was expected that these established hypertensives would be slower to respond to the therapy than those individuals in previous studies of high normal blood pressure. We therefore did not use a long lead-in period of just measuring blood pressures, but instead proceeded with the therapy within one week of screening. With the excellent response to the training, we did not have a period of stable readings, but instead saw falling pressures over the first few weeks.

Future investigations should include a holding period for 4 weeks before beginning the therapy, to allow for baseline data collection.

Conclusions

From this study, it is evident that regular isometric handgrip training can be a useful tool in the treatment of hypertension in a family practice environment. With the recent advances in miniaturization and electronic devices, it is now possible to prescribe this therapy for home use. Further trials will be needed to establish a definite benefit to the population as a whole, but as for these cases, it was effective in their management of blood pressures.

Acknowledgments

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Figure Legends

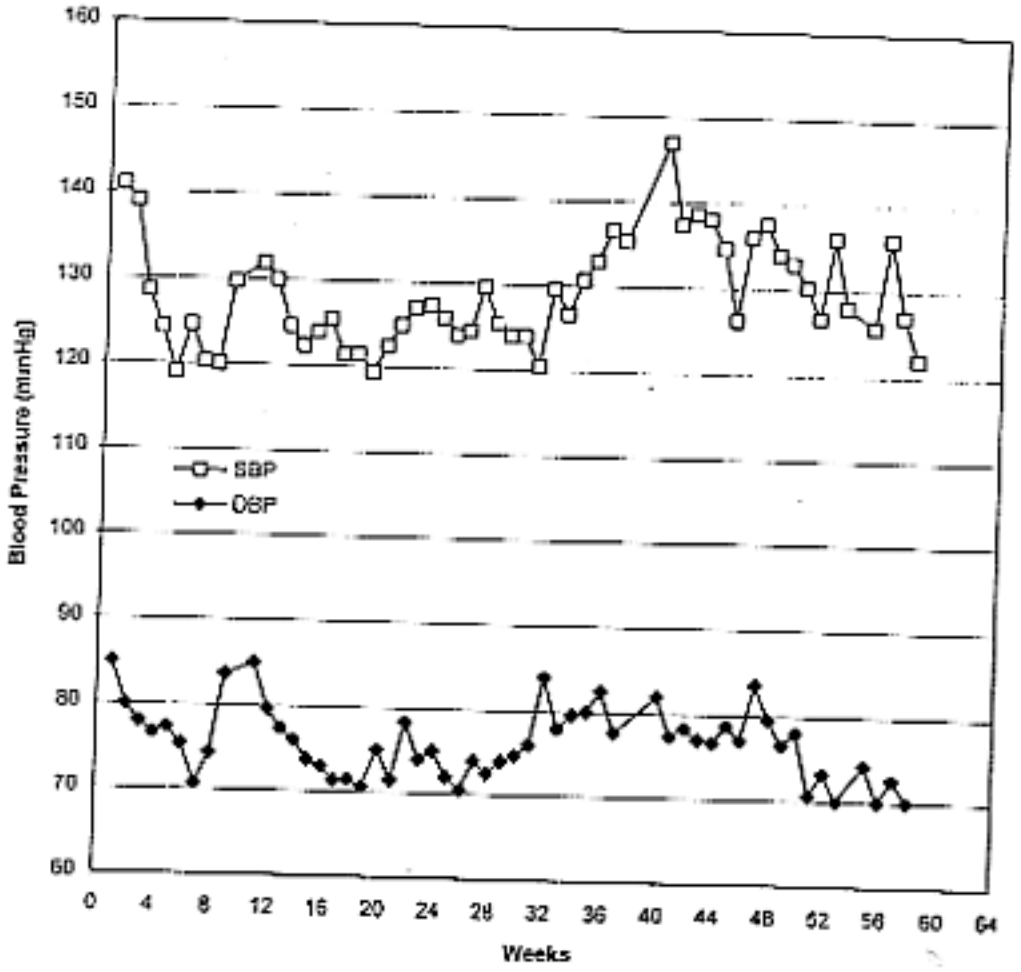
Figure 1. Weekly mean blood pressure measurements from a 73 yr old female over her 58 week participation in isometric handgrip therapy

Figure 2. Weekly mean blood pressure measurements from a 48 yr old male over his 73 week participation in isometric handgrip therapy

Figure 3. Weekly mean blood pressure measurements from a 43 yr old male over his 53 week participation in isometric handgrip therapy

Figure 4. Weekly mean blood pressure measurements from a 69 yr old male over his 73 week participation in isometric handgrip therapy

Fig 1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Blood Pressure (mmHg)
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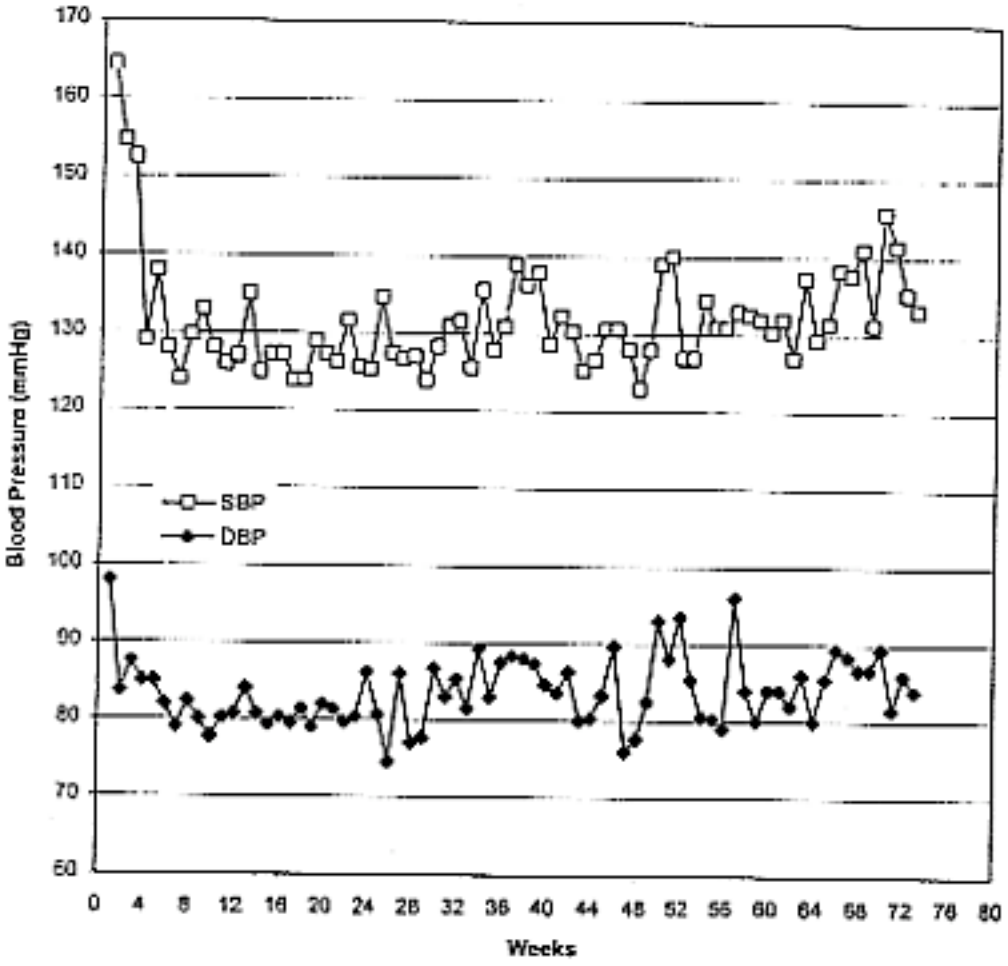
56
60
64
Weeks

Fig 2


Blood Pressure (mmHg)
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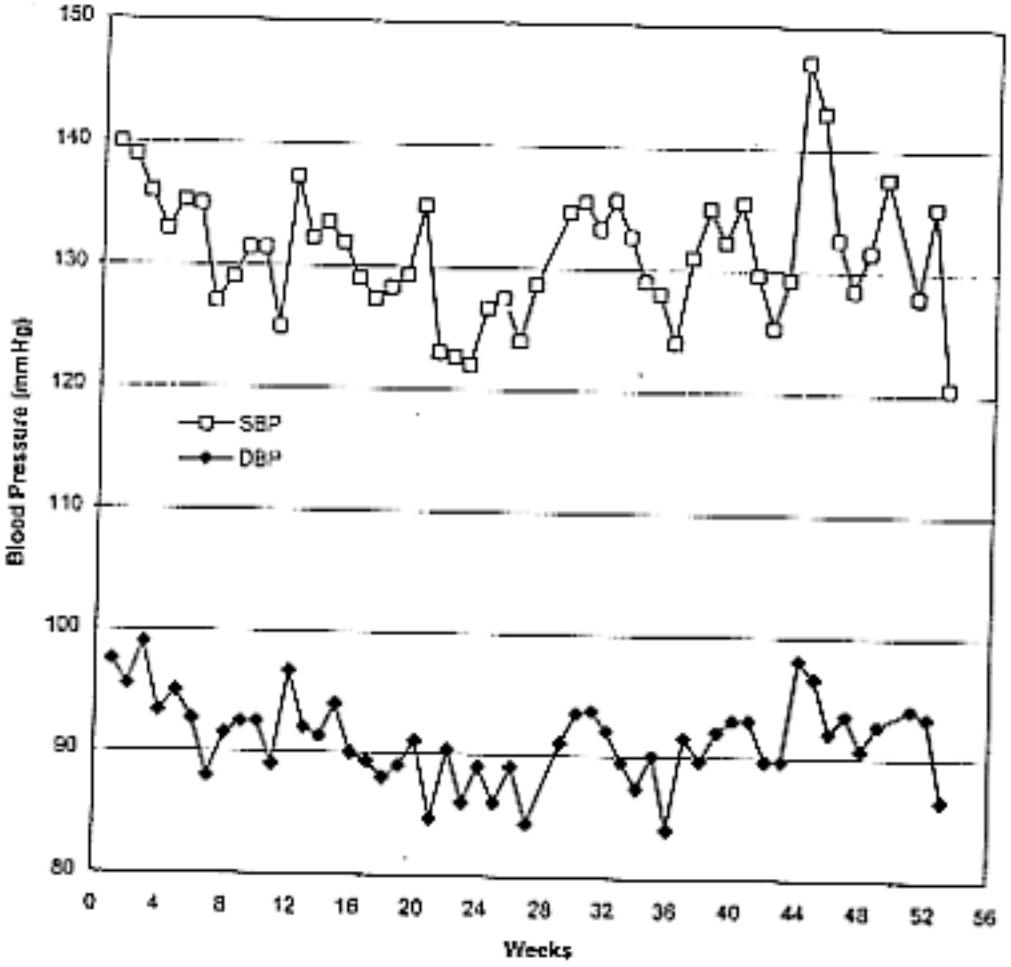
Weeks

Fig 3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Blood Pressure (mmHg)
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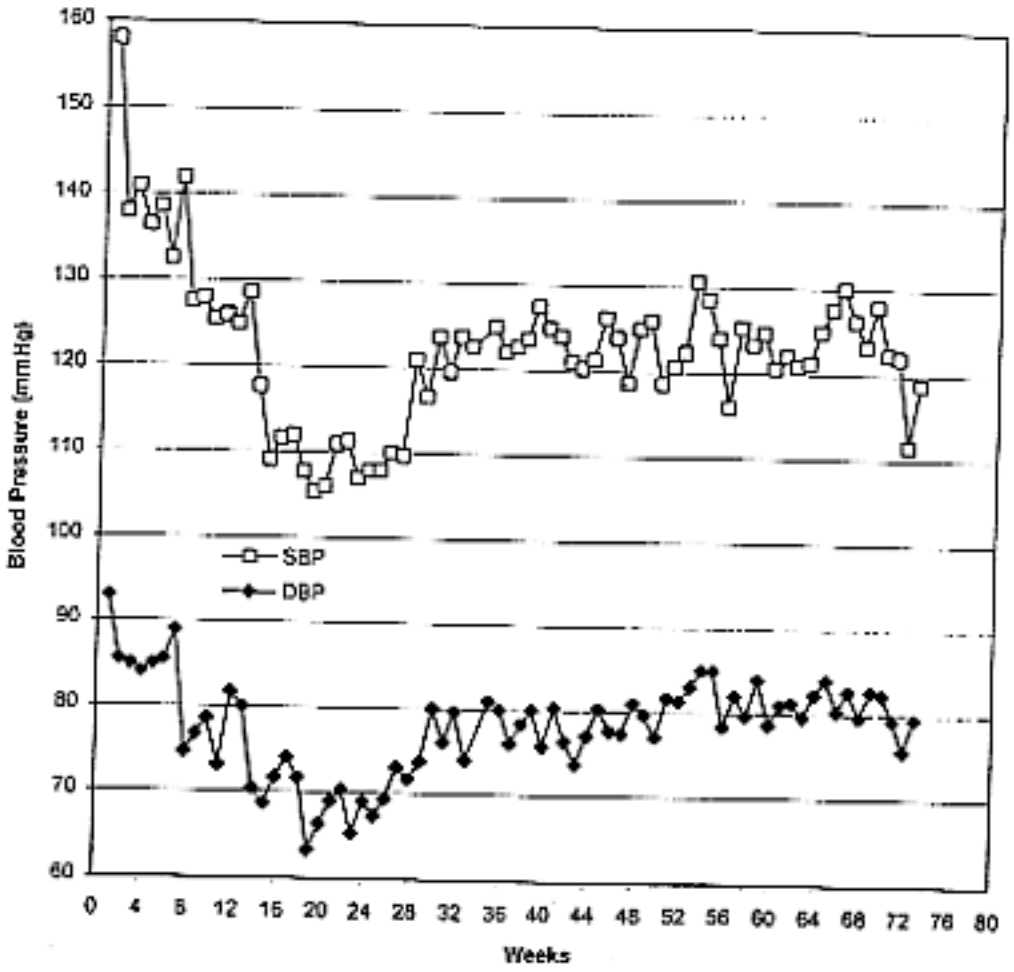
Weeks

Fig 4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Blood Pressure (mmHg)
SBP
DBP
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 76 80
Weeks

Figure 1: Blood Pressures
(Individual Hypertensive Cases)