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Medically Supervised Water-Only Fasting in the Treatment of Borderline Hypertension

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ABSTRACT

Background: Hypertension-related diseases are the leading causes of morbidity and mortality in industrially developed societies. Surprisingly, 68% of all mortality attributed to high blood pressure (BP) occurs with systolic BP between 120 and 140 mm Hg and diastolic BP below 90 mm Hg. Dietary and lifestyle modifications are effective in the treatment of borderline hypertension. One such lifestyle intervention is the use of medically supervised water-only fasting as a safe and effective means of normalizing BP and initiating health-promoting behavioral changes.

Methods: Sixty-eight (68) consecutive patients with borderline hypertension with systolic BP in excess of 119 mm Hg and diastolic BP less than 91 mm Hg were treated in an inpatient setting under medical supervision. The treatment program consisted of a short prefasting period (approximately 1–2 days on average) during which food consumption was limited to fruits and vegetables followed by medically supervised water-only fasting (approximately 13.6 days on average). Fasting was followed by a refeeding period (approximately 6.0 days on average). The refeeding program consisted of a low-fat, low-sodium, plant-based, vegan diet.

Results: Approximately 82% of the subjects achieved BP at or below 120/80 mm Hg by the end of the treatment program. The mean BP reduction was 20/7 mm Hg, with the greatest decrease being observed for subjects with the highest baseline BP. A linear regression of BP decrease against baseline BP showed that the estimated BP below which no further decrease would be expected was 96.0/67.0 mm Hg at the end of the fast and 99.2/67.3 mm Hg at the end of refeeding. These levels are in agreement with other estimates of the BP below which stroke events are eliminated, thus suggesting that these levels could be regarded as the "ideal" BP values.

Conclusion: Medically supervised water-only fasting appears to be a safe and effective means of normalizing BP and may assist in motivating health-promoting diet and lifestyle changes.

INTRODUCTION

Hypertension-related diseases are the most common causes of morbidity and mortality within industrially advanced societies (Stamler et al., 1993). Each year in the United States there are 500,000 victims of stroke. Hypertension is a major causal factor in these in-

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cidents, one third of which are fatal (Taylor et al., 1996). Hypertension also is thought to be the most readily preventable and controllable factor in congestive heart failure, a disease involved in more than 400,000 deaths and 2,000,000 coronary events each year in the United States (Kannel et al., 1994).

Given the magnitude of the causal role played by hypertension in these disease processes, it is not surprising that many treatment alternatives have received considerable research attention (Kaplan, 1998a) (Table 1). Surprisingly, the vast majority of individuals (68%) who die as a result of the pathologic changes associated with elevated blood pressure (BP) do so with systolic blood pressure of 120–140 mm Hg and diastolic pressure below 90 mm Hg. These ranges are below the threshold generally established for medical treatment (Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure, 1997).

According to the sixth report of the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure (Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure, 1997), hypertension is diagnosed when the systolic BP exceeds 140 mm Hg and/or the diastolic BP exceeds 90 mm Hg. Alternatively, hypertension is sometimes defined as the level of blood pressure elevation at which drug treatment is justifiable (Kaplan, 1998b). Under this second definition, a patient is diagnosed with hypertension when the effects of treatment are likely to be less destructive than the elevated BP. With currently available drug treatments, this situation is considered to be present when the average of multiple reliable readings among patients without concomitant risk factors or target organ damage exceeds 160 mm Hg systolic BP and/or 95–100 mm Hg diastolic BP (Hoes, 1995; Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure, 1997; Sever et al., 1993).

Both of these criteria, however, leave millions of people either medically unattended (i.e., below 160/95 mm Hg) and/or uninformed (i.e., below 140/90 but still at elevated risk) of the seriousness of their condition. Drug treatment below 160/95 mm Hg is usually not advocated, and is rarely indicated below 140/90 mm Hg (Kaplan, 1998c). Yet, a patient with a BP of 136/88 mm Hg, for example, is at approximately five times greater risk of stroke than a patient with a BP of 110/70 mm Hg (Stamler et al., 1993).

A meta-analysis of nine prospective studies also found no evidence of a threshold level at which lower levels of BP were not associated with lower risks of stroke and congestive heart disease (CHD) (MacMahon et al., 1990). A positive linear association between BP and mortality was demonstrated, with an approximate

TABLE 1. RESULTS OF PREVIOUS STUDIES REPORTING BLOOD PRESSURE REDUCTIONS ASSOCIATED WITH VARIOUS INTERVENTIONS STRATEGIES

	Systolic (mm Hg)	*Diastolic (mm Hg)*	*Source*
Body weight loss[a]	−1.6	−1.3	Staessen et al. (1989[a])[e]
Sodium restriction[b]	−16.0	−9.0	MacGregor et al. (1989[a])
Vegetarian/high-fiber diet	−2.8	−1.1	Appel et al. (1997[a])
Alcohol intake[c]	−4.8	−3.3	Puddey et al. (1992[a])
Exercise[d]	−6.5	−6.5	Arroll and Beaglehole (1992[a])[e]
Combination of low-fat, low-salt, vegan diet, and exercise	−17.0	−13.0	McDougall et al. (1995[a])
Effects of standard antihypertensive drug treatment	−12.0	−6.0	Kaplan (1998[a])

[a]Blood pressure reduction per kilogram of body weight loss.
[b]Sodium intake reduced from 200 mmol/d to 50 mmol/d.
[c]Reduction of alcohol intake from 440 mL to 66 mL/wk.
[d]Average of 3 weekly events of aerobic activity.
[e]Meta-analysis of studies.

1% increase in mortality from all causes for each 1 mm Hg increase in systolic BP (Hypertension, Detection, and Follow-Up Program, 1979). MacMahon et al. (1990) further pointed out that at essentially any level down to at least 70 mm Hg, a diastolic BP increment that is persistently 5 mm higher is associated with at least a 34% increase in stroke incidence and a 21% increase in CHD risk.

Although medication may have a net positive benefit for certain patients with significantly elevated BP, the more relevant message is disquieting: most people who die of coronary artery disease, congestive heart failure, or stroke do not have BP in ranges sufficiently elevated to warrant drug treatment (Kaplan, 1998d). Given the current limitations of drug treatment, the exploration of alternative, noninvasive methods of BP control should be sought.

There exists an impressive body of scientific literature indicating substantial effects of conservative health promoting interventions on BP control (Hoes, 1995; Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure, 1997; Kaplan, 1998a; Sever et al., 1993). These interventions include regular aerobic exercise, bodyweight reduction, smoking cessation, increased dietary fiber intake, alcoholic beverage restriction, consumption of a vegan-vegetarian diet, and sodium intake restriction. The advantages of these interventions are threefold. First, there are virtually no iatrogenic effects. Second, the degree of BP reduction is in some cases greater than the average reduction of 12/6 mm Hg commonly obtained by drug therapies (Kaplan, 1998e). Third, not only are these approaches typically devoid of iatrogenic effects, but each is associated with known comprehensive health benefits.

While the modification of a single lifestyle variable might not result in BP reductions comparable to those expected with medication, the use of multiple modifications undertaken simultaneously has much greater promise (Table 1). This paper reports the results of such an effort, wherein multiple lifestyle variables were controlled in an inpatient environment. Suspension of smoking and alcoholic beverage use, body weight loss, sodium restriction, and dietary modifications were simultaneously applied in a short-term inpatient experience that also included a period of medically supervised water-only fasting.

The purpose of this investigation was to test the effects on BP of water-only fasting together with multiple lifestyle modifications in a medically supervised controlled environment. The study allowed for the elimination of smoking and alcoholic beverage use, and restriction of sodium intake. The water-only fast also facilitated body weight reduction. After the fasting process was completed, a low-fat, low-sodium, vegan diet was provided. It was our expectation that the reduction in BP obtainable with this safe noninvasive approach would exceed the results typically demonstrated by any single lifestyle modification used independently.

METHODS

Patients included 68 self-referred adults, consecutively admitted for inpatient care for the treatment of a variety of health concerns over a period of 3 years (1997–1999). Presentation with a baseline systolic BP of 120–140 mm Hg and a diastolic BP of less than 91 mm Hg was required for inclusion. Baseline measures were taken the first morning after patient arrival at the facility. Initial mean BP levels were 129/78 mm Hg (Table 2). All patients who met these specific inclusion criteria during this 3-year period were included in the study.

BP measurements were made by staff doctors utilizing standard recommended procedures (Baum, 1987). A single BP measurement was taken daily at morning rounds between 7:30 AM and 9:00 AM with a portable Baumanometer Mercury Syphgmomanometer (Copiague, NY), with the patients in the supine position. Pulse and BP were measured using the same arm, recording Karotokof sounds 1 and 5.

For at least 2 full days prior to (or in some cases after) their arrival at the clinic, patients were instructed to eat a diet consisting exclusively of fresh raw fruits and vegetables and steamed vegetables. Once this transition diet program and examination procedures were completed, and informed consent was ob-

TABLE 2. MEANS OF BLOOD PRESSURE (mm Hg), BODY WEIGHT (kg), AND BODY MASS INDEX (BMI) FOR A SAMPLE OF SIXTY-EIGHT PATIENTS MEASURED AT THREE TIME POINTS THROUGH A WATER-ONLY FASTING TREATMENT PROGRAM

Variables	*Results* *Mean ± SD*
Number of subjects	68
Age (years)	54.6 ± 12.8
Height (m)	1.66 ± 0.1
1. Baseline	
Systolic BP (mm Hg)	129 ± 6.4[a]
Diastolic BP (mm Hg)	78 ± 8.0[a]
Weight (kg)	77.1 ± 18.1[a]
BMI	27.7 ± 5.4[a]
Pulse pressure (mm Hg)	51.0 ± 7.5[a]
Fasting period (days)	13.6 ± 7.0
2. End of water-only fasting	
Systolic BP (mm Hg)	112.2 ± 10.0[b]
Diastolic BP (mm Hg)	71.5 ± 7.3[b]
Weight (kg)	69.4 ± 16.0[b]
BMI	24.9 ± 4.9[b]
Pulse pressure (mm Hg)	40.6 ± 9.1[b]
3. End of supervised refeeding (end of treatment program)	
Systolic BP (mm Hg)	108.9 ± 10.2[c]
Diastolic BP (mm Hg)	71.0 ± 7.7[b]
Weight (kg)	70.0 ± 16.1[b]
BMI	25.2 ± 4.9[b]
Pulse pressure (mm Hg)	37.9 ± 7.6[c]
Postfasting refeeding period (days)	6.0 ± 3.1
Duration of total treatment program (days)	19.6

[a,b,c]Comparable means in each of the three time periods were tested for statistical significance using the ANOVA procedure based on Duncan's Multiple Range test. Means with a different letter are significantly different ($p < 0.05$) for each variable of interest across each of the three time points.

BP, blood pressure; SD, standard deviation; ANOVA, analysis of variance.

tained, patients began the water-only fasting program.

THERAPY

Patients were enrolled into the water-only fasting regimen in an inpatient environment for periods ranging from 4 to 40 days (Table 2). Water-only fasting is the complete abstinence from all substances—food, tea, juice, noncaloric beverages, etc.—with the sole exception of distilled water *ad libitum* (with a minimum of 40 ounces daily). Patients' activities were restricted, because even moderate activity during a water-only fast can double energy utilization (Cahill, 1978). Allowable quiet activities included reading, listening to music, and watching instructional videos. Patients were also allowed to participate in group lectures, food preparation demonstrations and classes, and individual medical and psychologic consultations.

Water-only fasting periods were terminated during periods of relative symptom stability and after BP reduction stabilized. In a few cases, nonclinical issues, such as limited time available, precipitated the premature termination of fasting. The water-only fasting period was followed by a period of supervised refeeding initiated by the consumption of juices made from fresh raw fruits and vegetables. Patients received 12 ounces of fresh juice every 3 hours during the juice phase (approximately 1 day of juices only for each week of water-only fasting). The juice phase was then followed by a diet of fresh raw fruits and vegetables (approximately 1 day for each week of water-only fasting). After these transitional regimens, a diet of whole natural foods was introduced. This diet included fresh fruits and vegetables, steamed and baked vegetables, whole grains and legumes, and small quantities of raw unsalted nuts and seeds. The diet specifically excluded any meat, fish, fowl, eggs, dairy products, or added oil, salt, or sugar. Bread products and other processed foods were also excluded. Cooked meals were prepared utilizing recipes exclusively from the *Health Promoting Cookbook* (Goldhamer, 1996). After the juice phase, patients were allowed gradual reintroduction of moderate exercise.

SAFEGUARDS

Patients were cautioned throughout the water-only fasting period regarding orthostatic hypotension. Patients received twice-daily consultations with a staff doctor. All fasting protocols were carried out according to the standards set forth by the International Association of Hygienic Physicians (IAHP; 1997). The study was approved by the Human Subjects Committee of the IAHP.

ADDITIONAL MEASURES

Patients were additionally monitored with at least twice-weekly urinalyses and once-weekly blood tests including a complete blood count with differential, a multiple clinical chemistry panel including electrolytes, liver enzymes, serum proteins, creatinine, uric acid, bilirubin, glucose, lipids, and erythrocyte sedimentation rate. Additional testing was performed when clinically indicated.

STATISTICAL ANALYSIS

Descriptive statistics, including means and standard deviations for the outcome variables of interest were computed for the 68 eligible inpatients at three relevant time points: (1) baseline (the first morning after arrival at the facility and start of water-only fasting), (2) the end of fasting, and (3) the end of supervised refeeding. The last measurement at the end of the supervised refeeding denoted the conclusion of treatment for each subject. Exploratory analyses revealed no significant differences in systolic or diastolic BP values by gender or age group, hence results were combined and are not shown separately for age or gender. In addition to analyzing the total treatment response, from baseline to the end of treatment, patient responses to the fasting process alone also were analyzed. The daily fasting response was computed by dividing the total fasting response by duration of fast for each patient. Analyses of variance (ANOVA) procedures were used to test statistical significance of the effect of fasting on BP, as well as for testing significance for the effect of the total treatment program through supervised refeeding. The probability levels of significance reported are based on the two-tailed t test. All statistical analyses were conducted using SAS version 6.1 (SAS Institute, Inc., Cary, IN, 1991).

RESULTS

The effects of medically supervised water-only fasting and refeeding on BP were large and statistically highly significant. The water-only fasting period was followed by a supervised feeding period for a length of time (average of 6 days) of about one half as long as the water-only fasting period (average of 13.6 days). The average length of treatment from admission to discharge was 19.6 days. Body weight over the entire treatment period decreased by an average of 7.1 kg and mean body mass index (BMI) declined from to 27.7 to 25.2.

BP dropped during the water-only fasting, and postfasting (supervised refeeding) periods (Table 2). Most of the decrease (84% for systolic BP and 91% for diastolic BP) occurred during the water-only fasting period (Table 2). It is of interest that the decrease in BP continued into the refeeding period when fresh fruits and vegetables were fed. Table 3 summarizes several regression equations indicating the relation be-

TABLE 3. REGRESSION ANALYSES

Equation	*Independent variable*	*Dependent variable*	*Slope*
Y = 0.68x − 67.1	Baseline SBP	SBP decrease	$p = 0.0008$
Y = 0.64x − 42.8	Baseline DBP	DBP decrease	$p < 0.001$
Y = 0.13x − 18.5	No. fasting days	SBP decrease	$p = 0.50$
Y = 0.20x − 4.2	No. fasting days	DBP decrease	$p = 0.18$
Y = −0.055x + 19.5	Weight change	SBP decrease	$p = 0.92$
Y = 0.035x + 6.4	Weight change	DBP decrease	$p = 0.79$

All measures of blood pressure (BP) decrease involve final BP measure after refeeding.
SBP, systolic blood pressure; DBP, diastolic blood pressure.

tween BP decrease and baseline BP, and between BP decrease and body weight reduction. The BP decreases shown in the table are those taken after refeeding, but are essentially the same as after the fasting period (data not shown). Mean BP decreases (systolic BP and diastolic BP) are strongly associated with the baseline BP, with a greater decrease observed for subjects with a greater baseline BP ($p <$ 0.0001). However, the mean BP decrease is not significantly related to the number of fasting days, or the amount of weight the subjects lost.

DISCUSSION

These findings document the effectiveness of water-only fasting and dietary restriction for the treatment of borderline hypertension. Approximately 8 of 10 patients (82%) had blood pressures of 120/80 mm Hg or below by the conclusion of the supervised refeeding period.

Normalization of BP may be the result, according to Kaplan (1998a), of a variety of causes including (1) natriuresis; (2) body weight loss; (3) control of hyperinsulinemia and other insulin resistance syndrome pathologies; (4) reduction of sympathetic nervous activity (Overton, et al., 1997); and/or (5) other mechanisms. Natriuresis is likely to be responsible for a significant portion of the observed reduction in both systolic and diastolic BP (Trials of Hypertension Prevention Collaborative Research Group, 1992), although improvement in sympathetic tone also may also be quite significant. No previous investigations, however, have reported effects of natriuresis on systolic BP of the magnitude of the effect observed here (20 mm Hg); thus, other explanations, including those noted above, should also be considered.

Of particular interest is the fact that the final mean BP achieved (109/71) is similar to levels thought to be consistent with excellent health. Other investigators have reported that a mean BP of 110/70 mm Hg is consistently associated with better health compared to traditional or "normal" levels in the area of 120/80 mm Hg (C.R.G. Eastern Stroke and Coronary Heart Disease Collaborative Research Group, 1998).

Although the greatest amount of the decrease in BP in this study occurred during the fasting period alone, it is notable that BP was further reduced during refeeding. This finding suggests that normalization of BP may be indefinitely sustainable with a health-promoting diet. Future investigations should incorporate long-term follow-up in their study design to verify that BP reductions are sustainable. In a study following this same protocol in the treatment of hypertension, a limited follow-up of 42 patients demonstrated BP stability after 27 weeks. Also of interest is the present finding of no significant correlation between body weight loss and systolic BP/diastolic BP reduction (Table 3). This suggests that the observed reductions in BP are not merely an artifact of body weight loss. In fact, as patients rehydrated during the refeeding period, systolic BP continued to be reduced, and did so significantly.

The BP decrease induced by fasting is strongly associated with baseline BP (Table 3). This is not surprising, because those with the highest BP had the furthest to fall. Of interest is the question as to how far they could be expected to fall, given this treatment model. Examining the regression findings, we observe that by solving for x where $y = 0$ (i.e., the point where no further BP decrease can be expected) yields 99.2 mm Hg for systolic BP and 66.9 mm Hg for diastolic BP. Said another way, a BP of 99.2/66.9 mm Hg is that pressure that would not be expected to be further reduced by the treatment. As noted above, these data correspond well with other studies suggesting that the ideal BP is even less than the touted 110/70 mm Hg level. Two major investigations have produced data suggesting that stroke risk may continue to decline when diastolic blood pressures are reduced below 70 mm Hg (Prospective Studies Collaboration, 1993).

A major factor in the development of high blood pressure is likely the result of dietary excesses, especially excess intake of sodium and fat. Water-only fasting followed by a low-fat, low-sodium plant-based diet is a safe and effective method for reversing the effects of such dietary excess. Perhaps the large observed effects, viewed with this in mind, should not be seen as particularly remarkable. It is notable that the observed effect sizes are consistent with our previous investigation of water-only fasting with hypertensive patients, wherein the average observed decrease in blood pressure was 37/13 mm Hg (Goldhamer et al., 2001). We believe that these previous results were more striking than those in the present investigation merely because in the previous study, subjects initial mean BP levels were significantly higher (159/89 mm Hg) and thus they had further to fall.

In addition to providing for the rapid normalization of blood pressure and body weight, water-only fasting may have another, and perhaps more important, benefit. A period of water-only fasting is a period of sensory deprivation for taste nerves. This deprivation then results in a rapid sensitization to subtle taste stimuli. Similar phenomena are observed across all sensory modalities such as the normal neuroadaptation to changes in illumination, noise, or olfactory stimulation (e.g., if bright lights are somewhat dimmed, visual nerves will adapt to this lower level of lighting, which soon do not seem dim). Present dietary patterns in industrialized societies use high-fat, high-sodium foods that not only promote hypertension, but also promote a palate that is generally intolerant of low-fat, low-sodium, high-potassium plant foods (Mattes, 1993). A period of sensory deprivation, such as water-only fasting, is a potentially powerful intervention for resensitizing taste nerves—and makes health-promoting fare much more palatable. This experience has been consistently observed in our clinic.

The present study effectively replicates the remarkable effects of a water-only fasting treatment program previously demonstrated with patients diagnosed with hypertension (Goldhamer et al., 2001). The present effort suggests that a prolonged water-only fasting experience followed by a plant-based diet, low in fat and sodium, may substantially resolve subclinical abnormalities that result in elevated risk of stroke, CHD, congestive heart failure, and other common pathologies.

Finally, it should be noted that this treatment was administered in a medically supervised inpatient environment, thus would not be appropriate for unsupervised use.

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