Original Article

THE EFFECT OF HIGH-CALCIUM AND HIGH-POTASSIUM DIET ON GRADE-I HYPERTENSION AND HIGH NORMAL BLOOD PRESSURE

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ABSTRACT

Objective: To determine the effect of calcium, potassium and calcium-potassium rich diet on grade I hypertension and high normal blood pressure.

Methodology: This was a prospective study done at Shahid Madani Research Center, Tabriz, Iran during September 2002-June 2003. One hundred three subjects with grade I hypertension (140-159/90-99 mmHg) and high normal blood pressure (130-139/85-89mmHg) were randomized into 4 Groups. Group C, P, CP received high – calcium diet (>800mg /day), high – potassium diet (> 4000mg/day), a combined high-calcium, high – potassium diet, respectively. Group O was as control group. After one month, blood pressure was compared to baseline values.

Results: Decrease of systolic and diastolic blood pressure in all three groups(C,P,CP) was significant, compared to control group, which was more significant in group CP than group C or group P ($P<0.05$).

Conclusion: Hypertension specially grade-I and high normal BP can be prevented and treated by an increase in intake of both calcium (1200mg/day) and potassium (4000mg/day)

KEY WORDS: Calcium, Potassium, Hypertension.

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INTRODUCTION

Hypertension (HTN) is one of the most important health problems because of its high prevalence, severe complications, and being asymptomatic. It chronically causes complications and leads to CVA (Cerebrovascular Accident), sudden heart attacks, chronic renal failure and etc.[1] Although its same prevalence in family members and within population suggests genetic as a causing factor, epidemiologic studies have shown a relationship between environmental factors and HTN. As, a study performed on adult immigrants from rural areas to urban regions showed that the pattern of their BP (Blood Pressure) changed and became like their new neighbors.[2] Vegetarians have low BP levels than omnivores and replacement of a omnivorous diet with a vegetarian diet lessens blood pressure in subjects with HTN or normal BP.[2,3] DASH studies (Dietary Approach to Stop Hypertension) have shown that fruits, vegetables, dairy products and their combination, regardless to their types, have caused significant decrease in systolic and diastolic BP in a large group of hypertensive

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patients.[4] Effective nutrients in the above diet were probably potassium and calcium. Because of controversies in the effect of calcium and potassium supplements and low number of the performed studies with, we decided to perform this clinical trial to determine the effect of a high – calcium, high – potassium and also combined high- calcium, high – potassium diet on cases with HTN and high normal BP via some simple nutritional recommendations.

SUBJECTS AND METHODS

This clinical trial was performed on 103 cases with grade I HTN (140-159/90-99mmHg) and high normal BP (130-139/85-89mmHg) during September 2002-June2003. According to SPRT (Sequential Probability Ratio Test) a maximum of 35 cases was needed in each group. If our intervention didn't have a meaningful effect till the 35th case, the results of our study wouldn't be significant. After obtaining inform consent and approval in ethics committee, BP (twice), weight and height of the cases were measured. The 24-hour dietary recall and food record questionnaire for two days were used to obtain data on food consumption.

Then cases were randomized into four groups. The first group (group C) received a high-calcium diet which had more than 800mg calcium, the second group (group P) received a high potassium diet which had 4000mg potassium and the third group (group CP) received a combined high-calcium and high potassium diet. The forth group (group O) was considered as the control group and continued their common diet. After one month of following the given diets, their BP was measured twice and was compared to baseline values. A one-day 24-hour dietary recall and a 2-day food record questionnaire were completed. Other nutrients were like their routine diet. No recommendation was given to the patients about avoiding or lessening the amount of salt intake. Data were analyzed by chi-square, paired T-test, ANOVA and SPRT. $P<0.05$ was considered statistically significant.

Table-I: mean age of subjects (Years)

Group	*Number*	*Mean*	*Standard deviation*
O	31	50.71	15.49
C	24	50.13	16.54
P	25	46.04	11.11
CP	23	47.78	14.00
Total	*103*	*48.79*	*14.40*

O: group control
C: group calcium
P: group potassium
CP: group calcium and potassium

RESULTS

Mean age of the subjects was 48.79 years. The difference among the groups was not significant. Table-I shows mean age and standard deviation of the cases of each group.

Table-II shows mean and standard error of BP in four groups before and after intervention. Mean systolic and diastolic BP decline in all three case groups is significant, compared to control group ($P<0.05$).

Table-III shows mean dietary intake and difference in calorie, sodium, calcium and potassium before and during intervention in four groups. In all groups, the intake of calorie before intervention provides 74.8% of RDA (Recommended Dietary Allowance) which has increased to 78.3% of RDA, during intervention. This reveals that daily calorie intake is less than recommended amounts. In groups C and CP, calcium intake has significantly increased after intervention but in groups P and O, the difference of calcium intake before and during

Table-II: Mean and SE of systolic and diastolic BP before and after intervention in four groups.

Group	*Number*	*SBP[1] (mmHg)*			*DBP[2] (mmHg)*		
		Before	*after*	*difference*	*Before*	*after*	*difference*
O	31	141± 2*	138±2 .3	-4.1935	90.23± 1.53	88±1.2	-3.0645
C	24	143.7±2.6	133.9±2.2	-9.8917	91.5±1	83.6±1.4	-7.875
P	25	143.2±2.2	131.6±1.3	-11.6	89.2±1.34	82.4±1.45	-6.8
CP	23	145±2.7	127.3±2.6	-18.6957	92.6±1.7	83.8±1.8	-9.7826

*mean± Standard Error, [1] .SBP: Systolic blood pressure, [2] .DBP: Diastolic blood pressure

Table-III: P value, mean dietary intake and difference in calorie, sodium, calcium and potassium before and after intervention in four groups

	calorie		*sodium*		*calcium*		*potassium*	
Group	*Difference*	*P value*	*Difference*	*P value*	*Difference*	*P value*	*Difference*	*P value*
O	-118.26 (1693.42-1575.16)	>0.05	+159.1 (1980.77- 2139.87)	>0.05	-37.42 (637.58-600.16)	>0.05	-66.9 (1968-1901.10)	>0.05
C	+39 (1768.50-1807.50)	>0.05	-568.96 (2625.17-2056.21)	0.039	+285.37 (600.92-886.29)	0.033	+83 (2169-2252)	>0.05
P	+31.68 (1477.72-1509.40)	>0.05	-244.56 (2337.40-2092.84)	>0.05	+42.32 (535.52-577.84)	>0.05	+710.64 (1418.24-2128.88)	0.023
CP	+364.57 (1460.52-1825.09)	0.045	+248 (2215.96-2463.96)	>0.05	+493.96 (579-1072.96)	0.008	+860.92 (1884.17-2745.09)	0.028

intervention is not significant and its intake is less than RDA. In groups P and CP, intake of potassium has increased after intervention but it is still less than estimated minimum requirements. In groups C and O, it has not increased a lot and it is much less than estimated minimum requirements. In all groups, intake of sodium before and after intervention is the range of estimated requirements.

Table-IV shows mean difference of urine electrolytes before and at the end of intervention in four groups. In groups C and CP, urine calcium has significantly increased. In groups P and CP, urine potassium has significantly increased. These show that patients' compliance was good and they had followed their diets well. In groups C and CP, urine sodium has significantly increased and in group P, it has decreased.

DISCUSSION

Findings of this study showed that a high – calcium diet causes 9.89mmHg decrease in SBP and 7.87mmHg decrease in DBP which was statistically significant (P=0.02 and p=0.016, respectively). Takaji et al, showed that calcium supplement in the dosage of 1gr/day caused 6 mmHg decrease in SBP and 5mmHg decrease in DBP in hospitalized elderly patients.[5] Pan et al suggested calcium supplementation could reduce blood pressure in patients with mild and moderate hypertension.[6] Sanchez et al showed that calcium supplementation in the dosage of 1.5g/day for four weeks didn't have significant effect in reduction of blood pressure.[7]

According to importance of calcium in prevention and treatment of hypertension, taking high-calcium diet such as low-fat diary products and milk can be effective in decreasing BP. In addition, findings of this study showed that a high – potassium diet caused 11.6mmHg decline in SBP and 6.8mmHg decline in DBP, which was significant, compared to control group (P=0.003 and P=0.039, respectively).

More than 50 years ago, Adison reported that high intake of potassium had inverse effect on BP and recently some clinical trials have shown that intake of more potassium lessens BP in hypertensive patients.[8] Whelton et al showed that intake of potassium supplement caused

Table-IV: P value and mean difference of urine electrolytes before and after intervention in four groups

	Ca		*K*		*Cr*		*Na*		*Volume*	
Group	*Difference*	*P value*	*Difference*	*P value*	*Difference*	*P value*	*Difference*	*P value*	*Difference*	*P value*
O	+20.32 (108.87-129.19)	>0.05	+9.23 (1645.77-1655)	>0.05	-149.29 (900.42-751.13)	>0.05	-79.48 (2877.85-2798.37)	>0.05	-19.35 (1156.52-1137.17)	>0.05
C	+33.49 (123.09-156.58)	0.023	+55.32 (1692.18-1747.5)	>0.05	-94.53 (863.61-769.08)	>0.05	+581.3 (3083.98-3665.28)	>0.05	+183.65 (1197.39-1381.74)	>0.05
P	-5.46 (131-125.54)	>0.05	+935.63 (1495.75-2431.38)	0.015	-62.79 (876.04-813.25)	>0.05	-382.96 (3174.63-2791.67)	>0.05	+32.29 (1205.83-1238.12)	>0.05
CP	+29.87 (120.96-150.83)	0.031	+907.08 (1566.74-2473.82)	0.021	+17 (872.09-889.09)	>0.05	+519.25 (3085.57-3604.82)	>0.05	+305.21 (1157.83-1463.04)	>0.05

1.97mmHg decrease in DBP and 3.11mmHg decrease in SBP.[9] Geleijnse et al showed that increased intake of potassium could make an important contribution to the prevention of hypertension, especially in population with elevated blood pressure.[10] Suter et al showed that hypertension had an inverse relationship with intake of potassium.[11] The results of investigations on the intake of oral potassium can play an important role in treatment of hypertension and should be considered as a method in prevention and treatment of hypertension.

According to findings of our study, in group CP, SBP decreased by 18.69mmHg and DBP decreased by 9.75mmHg. Comparing to control group, there was a significant decrease in both systolic and diastolic BP (p=0.0001 and P=0.001, respectively). In group CP, both systolic and diastolic BP decline was more than other groups.

Mu et al showed that adequate supplement of potassium and calcium was an effective way to prevent hypertension and could promote reduction of arterial blood pressure in adolescents with higher blood pressure.[12] Karppanen et al showed that an increased content of potassium and calcium can lower blood pressure.[13] The results of our study showed that a combined high- calcium, high – potassium diet could decrease systolic and diastolic BP more that high – calcium or high – potassium diet.

Generally, according to findings of related studies, it can be concluded that increase of oral calcium intake to 1200mg daily especially via low –fat diary products can play an important role in decreasing BP. Also, an increase in oral potassium intake by consumption of fruits and vegetables, five times a day (4000mg), can significantly decrease BP. So, by increasing the intake of both calcium (1200mg/daily) and potassium (4000mg/dialy), hypertension can significantly be treated.

CONCLUSION

We recommend intake of low–fat diary products and milk, 3 times a day and vegetables and fruits high in potassium (banana, orange, etc) 5 times a day, to prevent and treat hypertension, especially grade I and also high normal blood pressure.

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