

고혈압환자에서의 마그네슘, 칼슘과 혈장 레닌의 연관성

김현승 · 김범수 · 이상일 · 김기택 · 강진호 · 김 향 · 이만호 · 박정로

Correlation between Serum Magnesium, Ionized Calcium
and Plasma Renin Activity in HypertensivesHyun Seung Kim, MD, Bum Soo Kim, MD, Sang Il Lee, MD, Ki Taek Kim, MD,
Hyang Kim, M.D., Jin Ho Kang, MD, Man Ho Lee, MD and Jung Ro Park, MDDepartment of Internal Medicine, Kangbuk Samsung Hospital, Sungkyunkwan University
School of Medicine, Seoul, Korea

ABSTRACT

Background and Objectives : Previous studies reported that sodium and potassium play an important role in the pathogenesis of hypertension. Recently attention has been directed towards a possible role of the divalent cations such as calcium, and magnesium. Plasma renin activity is also known to be related to divalent cations heterogeneously. This study investigated the relationships between serum magnesium and ionized calcium and plasma renin activity. **Materials and Methods :** The subjects consisted of 27 essential hypertensive patients and 25 normotensive controls. Criteria for hypertensive group in this study were systolic blood pressure ≥ 140 mmHg or a diastolic blood pressure ≥ 90 mmHg (JNC-VI, 1997). Inclusion criteria were normal urinalysis, no history of systemic illness, no intake of antihypertensive drugs, and no recent intake of any other medication. We took magnesium-loading test for a reliable method of assessing possible magnesium deficiency. **Results :** There was no significant difference between two groups in serum Magnesium concentration and other electrolytes and plasma renin activity. There was significantly higher rate in hypertensives than in normotensives in magnesium retention (hypertensive vs. normotensive : $63.56 \pm 12.21\%$ vs. $38.43 \pm 11.53\%$, $p < 0.001$). There was significant differences in ionized calcium between high-renin and low-renin hypertensives ($p < 0.001$). Plasma renin activity was correlated positively with serum ionized calcium in hypertensives ($r = 0.8147$; $p < 0.001$). **Conclusion :** These results suggest that plasma renin activity is a factor that can influence on serum ionized calcium in high-renin hypertensives. (Korean Circulation J 2000;30(8):16-22)

KEY WORDS : Essential hypertension · Magnesium · Magnesium · loading test · PRA · Ionized calcium.

서 론

1)2)

가

가

3)4)

가

가

5)

가

: 1999 11 22

: 2000 7 15

: , 110 - 102

108

: (02) 2001 - 2513, 2001 ·

: (02) 2001 - 2049

E - mail : kmedkim@cjdream.net

Korean Circulation J 2000;30(8):1017-1023

250 ml 가 2.4 mg 5% 8 24

Mg retained%(= 1 - (postinfusion 24hr urine Mg - preinfusion urine Mg/creatinine x postinfusion urine creatinine)/Total elemental Mg infused x 100)

EDTA

(plasma frozen) I

A radioimmunoassay kit(Clinical Assays Gamma-coat^R Plasma Renin Activity¹²⁵I RIA Kit, DiaSorin, USA)

(0.68 1.36 ng/ml/hr)

±

SPSS

independent sample t - test

Pearson's corr - elation p 0.05

결 과

Table 1. Baseline characteristics of the normotensive and hypertensive group

	Normotensive	Hypertensive
Total number	5	27
Age (years)	47 ± 17	55 ± 12*
BMI (kg/m ²)	22 ± 5	26 ± 3*
Systolic BP (mmHg)	122 ± 11	171 ± 19†
Diastolic BP (mmHg)	72 ± 8	103 ± 19†
MAP (mmHg)	100 ± 8	136 ± 19†
Hemoglobin (g/dl)	13.2 ± 1.7	13.1 ± 1.6
Hematocrit (%)	39.7 ± 5.4	39.0 ± 4.5
WBC (mm ³)	6844 ± 2248	7348 ± 2180
Platelet (mm ³)	247960 ± 73862	233777 ± 71629
Total protein (g/dl)	6.6 ± 0.7	7.0 ± 0.5
Albumin (g/dl)	4.0 ± 0.5	4.1 ± 0.3
BUN (mg/dl)	12.6 ± 4.4	14.7 ± 6.5
Creatinine (mg/dl)	1.0 ± 0.3	1.0 ± 0.3
AST (IU/L)	30 ± 16	25 ± 13
ALT (IU/L)	30 ± 18	26 ± 13
Serum sodium (mmol/L)	141 ± 3	142 ± 2
Serum potassium (mmol/L)	4.2 ± 0.6	4.1 ± 0.6
Serum chloride (mmol/L)	105 ± 2	105 ± 3
Plasma renin activity (ng/ml/hr)	1.57 ± 3.73	1.54 ± 1.51
Ionized Calcium (mmol/L)	0.8792 ± 0.3021	0.9778 ± 0.3064
Serum Magnesium (mg/dl)	2.17 ± 0.25	2.30 ± 0.24

* : p<0.05, † : p<0.001

가 가 (p<0.05), 27 (p=0.287), 가 12

15 (55.6%) , 가 12

(44.4%) , 가

가 ,

(Table 1.).

(p>0.05, Table 1.),

(p>0.05, Table 1.)

가 (: 63.56 ± 12.21% vs 38.43 ± 11.53%, p<0.001, Fig. 1)

(p<0.001, Fig. 2).

(p>0.05, Fig. 3).

(r = 0.8147 ; p<0.01, Fig. 4)

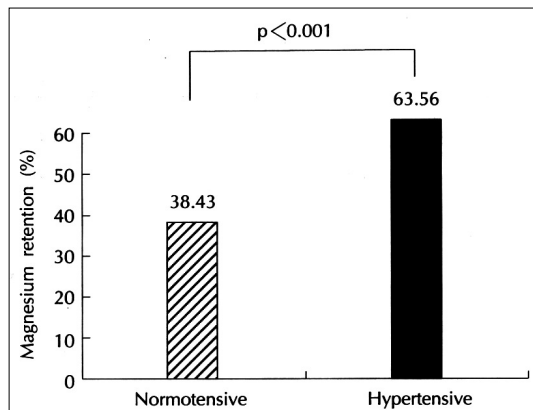


Fig. 1. Magnesium retention in normotensive and hypertensive subjects.

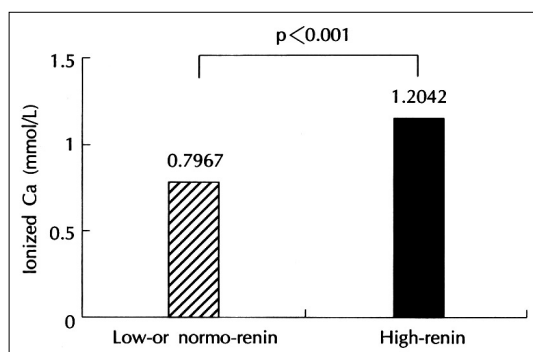


Fig. 2. Serum ionized calcium in low- or normo- renin and high-renin hypertensive subjects.

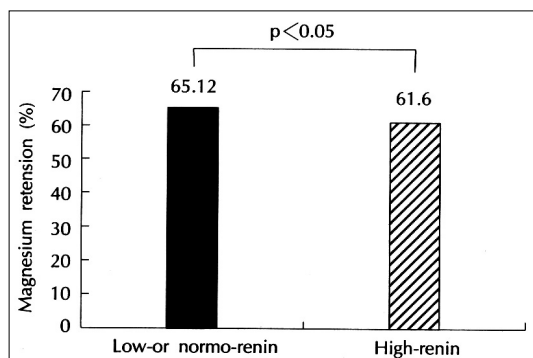


Fig. 3. Magnesium retention in low- or normo- renin and high-renin hypertensive subjects.

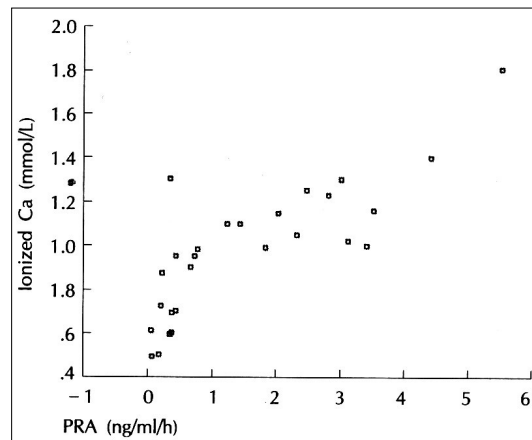


Fig. 4. Correlation between Plasma renin activity and serum ionized calcium in hypertensives ($r = 0.8147$; $p < 0.001$).

고 찰

가

가

14)17 - 19) Toyz

.⁸⁾ Resnick

가

.¹⁴⁾

가

가

가

가

.²³⁾

가

가

가

가

.¹⁴⁾

가

.¹⁴⁾

가

Sever

가

가

.²⁰⁾

가

가

가

.⁸⁾

가

요 약

가

연구배경 :

.⁸⁾²¹⁾²²⁾

가

가

가

가 ,

가

가

방법 및 배경 :

52

25

27

가 25

가 27

51

140 mmHg
90 mmHg (JNC - VI, 1997).

가

139 mmHg 89 mmHg

결 과 :

($p > 0.05$), 가
(: $63.56 \pm 12.21\%$ vs $38.43 \pm 11.53\%$, $p < 0.001$)

가 가
($p < 0.001$)

($p > 0.05$).

($r = 0.8147$; $p < 0.01$)

결 론 :

가

중심 단어 :

43

REFERENCES

1) Grobbee DE. *Electrolytes and hypertension: Results from*

- recent studies. Am J Med Sci* 1994;307(suppl 1):17-20.
- 2) Smith HT. *Electrolytes in the epidemiology, pathophysiology and treatment of hypertension. Prime Care* 1991;18:545-57.
- 3) Gilbert EK, D'Angelo G, Singer HA, Rembold CM. *Magnesium relaxes arterial smooth muscle by decreasing intracellular Ca^{2+} without changing intracellular Mg^{2+}* *J Clin Invest* 1992;82:1988-94.
- 4) Gold ME, Buga GM, Wood KS, Byrns RE, Chaudhuri G, Ignarro LJ. *Antagonistic modulatory role of Mg^{2+} and Ca^{2+} on release of endothelium-derived relaxing factor and smooth muscle tone. Circ Res* 1990;66:355-66.
- 5) Erne P, Burgisser E, Buhler FR. *Correlation of platelet calcium with blood pressure: Effect of antihypertensive therapy. N Engl J Med* 1984;310:1084-9.
- 6) Buckley BM, Smith SC, Beevers M. *Lack of evidence of low ionised calcium levels in systemic hypertension. Am J Cardiol* 1987;59:878-80.
- 7) Preston RA, Materson BJ, Reda DJ, Williams DW, Hamburger RJ, Cushman WC, Anderson RJ. *Age-Race subgroup compared with renin profile as predictors of blood pressure: Response to antihypertensive therapy. JAMA* 1988;280:1168-72.
- 8) Toyz RM, Milne FJ, Reinach SG. *Platelet and erythrocyte Mg^{2+} , Ca^{2+} , Na^{2+} , K^{2+} and cell membrane ATPase activity in essential hypertension in blacks. J Hypertens* 1992;10:571-8.
- 9) Altura BM, Zhang A, Altura BT. *Magnesium, hypertensive vascular diseases, atherogenesis, subcellular compartmentation of Ca^{2+} and Mg^{2+} and vascular contractility. Miner Electrolyte Metab* 1993;19:323-36.
- 10) Henrik SR, Peter MN, Lasse G, Steen B, Ole GL. *Magnesium deficiency in patients with ischemic heart disease with and without acute myocardial infarction uncovered by an intravenous loading test. Arch Intern Med* 1988;148:329-32.
- 11) Laitinen T, Hartikainen J, Vanninen E, Niskanen L, Geelen G, Lansimies E. *Age and gender dependency of baroreflex sensitivity in healthy subjects. Journal of Applied Physiology* 1988;84:576-83.
- 12) Yu H, Di Nicolantonio R. *Altered age-dependent modulation of tissue renin messenger RNA levels in the spontaneously hypertensive rat. Journal of Hypertension* 1996;14:871-80.
- 13) Veniant M, Whitworth CE, Menard J, Sharp MG, Gonzales MF, Bruneval P, et al. *Developmental studies demonstrate age-dependent elevation of renin activity in TGR (mRen2) 27 rats. American Journal of Hypertension* 1995;8 (12pt1):1167-76.
- 14) Resnick LM, Laragh JH, Sealey JE, Alderman MH. *Divalent cations in essential hypertension: Relation between serum ionised calcium, magnesium and plasma renin activity. N Engl J Med* 1983;309:888-91.
- 15) Hunt SC, Williams RR, Kuida H. *Different plasma ionised calcium correlations with blood pressure in high and low renin normotensive adults in Utah. Am J Hypertens* 1991;4:1-8.
- 16) Freis ED, Materson BJ, Flamenbaum V. *Comparison of propranolol or hydrochlorothiazide alone for treatment of hypertension: Evaluation of the renin-angiotensin system. Am J Med* 1983;74:1029-41.

- 17) Brunner HR, Sealey JE, Laragh JH. *Renin as a risk factor in essential hypertension: More evidence. Am J Med* 1973; 55:295-302.
- 18) Falkner B. *Differences in blacks and whites with essential hypertension: Biochemistry and endocrine. Hypertension* 1990;15:681-6.
- 19) Mitas JA, Holle R, Levy SB, Stone RA. *Racial analysis of the volume-renin relationship in human hypertension Arch Intern Med* 1979;139:157-60.
- 20) Sever PS, Peart WS, Gordon D, Beighton P. *Blood pressure and its correlates in urban and tribal Africa. Lancet* 1980;2:60-4.
- 21) Toyz RM, Milne FJ. *Racial differences in cell membrane ATPase and cellular cation content in urban South African normotensive and hypertensive subjects. Am J Hypertens* 1993;6:693-700.
- 22) Carafoli E, Guerini D. *Molecular and cellular biology of plasma membrane calcium ATPase. Trends Cardiovasc Med* 1993;3:177-84.
- 23) Berridge MJ. *Inositol triphosphate and calcium signalling. Nature* 1993;361:315-62.