Bone Mineral Density in Women With Essential Hypertension

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Recent studies have reported the abnormalities in calcium metabolism at the systemic level in human hypertension as well as in experimental hypertension. Because bone is the largest store of calcium in the body, the bone calcium content and mineralization may represent the entire calcium balance. The present study was undertaken to investigate the bone mineral density (BMD) in women with essential hypertension by means of the dual-energy X-ray absorptiometric (DXA) method. The DXA analysis showed a significant decrease in BMD in female hypertensive subjects compared with normotensive subjects. In addition, the BMD was inversely correlated with systolic blood pressure in women.

The 24-h urinary calcium excretion was significantly greater in female hypertensive subjects than in female normotensive subjects. Furthermore, the greater the urinary calcium excretion, the lower the BMD in women. The values of serum total calcium, total magnesium, ionized calcium, and 1,25(OH)2 vitamin D were not different between hypertensive and normotensive subjects. The results of the present study demonstrated that DXA provided an index of whole calcium balance, and suggest that high blood pressure might be associated with reduced BMD in female hypertension. Am J Hypertens 2001;14:704–707 © 2001 American Journal of Hypertension, Ltd.

Key Words: Bone mineral density, dual-energy X-ray absorptiometry, hypertension, women, calcium excretion.

It has been shown that abnormalities in calcium metabolism might play a key role in the pathophysiology in hypertension.1,2 Because bone is the largest store of calcium in the body, the bone calcium content and mineralization may represent the entire calcium balance. Increased calcium excretion and secondary activation of the parathyroid glands were reported in patients with essential hypertension.3,4 Thus, sustained calcium loss from kidney might lead to increased bone mineral loss in hypertension. In animal studies, hypercalciuria with high blood pressure increased the risk of bone mineral loss.1,5 Inoue et al6 examined the bone mineral density (BMD) in spontaneously hypertensive rats (SHR) by the dual-energy X-ray absorptiometric (DXA) method, and reported that trabecular bone in SHR had a lower mineral status than that of normotensive controls, not only in the adult but also in the young ages. However, it is still unclear whether hypertension might be associated with reduced BMD in humans. It is well recognized that osteoporosis is more likely to develop in women than in men.7 In the present study, therefore, we investigated BMD in women with essential hypertension by means of the DXA method.

Patients and Methods

Subjects

Thirty-one Japanese women with untreated essential hypertension were studied and compared with 14 normotensive control women. Consent was obtained from all participants after they were informed about the nature and objective of the study. They had no other diseases such as hematologic or hepatic disorders and were not taking hormone replacement therapy before the study. The characteristics and laboratory findings in both hypertensive and normotensive women are shown in Table 1.

Measurement of Bone Mineral Density

The BMD of lumbar spine (L2–L4) was measured in lateral view by means of the dual-energy X-ray absorptiometry...
The BMD (mean value of L2–L4) was represented as grams per centimeter squared.

Measurement of 24-h Calcium Excretion

From a sample of 15 female hypertensive subjects and 11 female normotensive subjects, the 24-h urine collection was obtained for determination of calcium excretion. Because differences in the dietary intake of NaCl are known to affect calcium transport by the renal tubules, we evaluated the calcium (mmol)/sodium (mmol) ratio in the collected urine during 24 h according to the method previously described. Consent was obtained from all participants after they were informed about the nature and objective of the urine collection.

Statistical Analysis

Values are expressed as means ± SEM. Statistical analyses were performed by the Student’s t test. Regression analysis was used to determine the relationship between BMD and both systolic blood pressure and the 24-h urinary calcium/sodium ratio. A P value less than .05 was accepted as the level of significance.

Results

BMD in Lumbar Spine in Hypertensive and Normotensive Women

Table 1 demonstrated the background of hypertensive and normotensive women. There were no differences in serum total calcium, total magnesium, ionized calcium, and 1, 25(OH)2 vitamin D between hypertensive and normotensive subjects.

The 24-h urinary calcium (mmol)/sodium (mmol) ratio (×100) was significantly greater in female hypertensive subjects than in female normotensive subjects.
3.10 ± 0.35, n = 15; female NT 2.04 ± 0.26, n = 11, P < .05. Furthermore, the greater the calcium/sodium ratio, the lower the BMD in women (Fig. 3).

**Discussion**

The results of the present study with DXA method demonstrated that BMD in lumbar spine was significantly decreased in female hypertensive subjects compared with female normotensive controls. The difference in mean age between hypertensive and normotensive groups, although it was not statistically significant, might partially account for the lower BMD in hypertensive patients.

We also described that BMD was inversely correlated with systolic blood pressure in women, which suggests that high blood pressure might be associated with the decrease in BMD in women. The finding might be consistent with a previous report of Cappuccio et al showing that the rate of bone loss at the femoral neck was increased with blood pressure in white women. Although our analysis was restricted to a small population of Japanese women and the findings may not be generalized to men and other ethnic groups, it would be possible that hypertension could be a risk factor for reduced BMD in women.

There has been much evidence showing that hypertension might be linked to the abnormalities in calcium metabolism, including an increased calcium excretion linked to salt intake. In the present study, we showed that the 24-h urinary calcium excretion (calcium/sodium ratio) was significantly greater in female hypertensive subjects than in female normotensive subjects. Furthermore, the greater the calcium/sodium ratio, the lower the BMD in women. The results might suggest that the increased urinary calcium could lead to a decrease in BMD in female hypertension.

The precise mechanisms responsible for the decreased BMD in female hypertension are still unclear. In women, the loss of endogenous estrogen might contribute to the rapid decrease in BMD at perimenopause and after menopause. Because estrogen also possesses antiatherosclerotic and antihypertensive properties, estrogen deficiency could lead to both an increase in blood pressure and a decrease in BMD in women. Lehrer et al examined the relationship between estrogen receptor variants and hypertension in women, and reported that the presence of the estrogen receptor B-variant allele might have increased the prevalence of hypertension in women. Both quantitative and qualitative alterations in estrogen effect may partially explain the rapid decrease in BMD in female hypertensive subjects. Further studies are necessary to assess more thoroughly the role of estrogen in the regulation of calcium metabolism in female hypertension.

In summary, the results of the present study with DXA method demonstrated that the BMD in the lumbar spine was decreased in female hypertensive subjects compared with normotensive controls. The data also showed that the BMD was inversely correlated with systolic blood pressure and the 24-h urinary calcium excretion in women. The finding might propose the hypothesis that high blood pressure might be associated with reduced BMD in female hypertensive subjects.

**References**