Bone Mineral Content and Blood Pressure: What Is the Pathophysiologic Link?

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Several recent studies in postmenopausal women and in men have found an inverse correlation between bone mineral content and blood pressure (BP). The concordance of bone disease and hypertension in elderly patients could merely be related to the fact that both conditions occur with advancing age. In the current issue of the Journal, Afghani and Johnson\(^1\) present data on the relationship between BP and bone mineral density in premenopausal women. The investigators measured bone mineral content by dual-energy X-ray absorptiometry and resting BP in 33 obese Hispanic women. Even after controlling their data for age, body weight, and fat-free mass, an inverse relationship persisted. Hypertensive women had lower bone mineral content than normotensive women. These findings suggest that the relationship between hypertension and bone mineral content may come about through a pathophysiologic link between BP regulation and calcium metabolism.

Although this study is limited by its observational nature, which precludes identifying causal associations between BP and bone mass measurements, possible mechanisms exist that may link bone disease and hypertension. McCarron et al\(^2\) were the first to show an increase in urinary calcium excretion in patients with essential hypertension. The currently favored hypothesis to explain the relationship between bone mineral content and hypertension is that hypercalciuria, and thereby bone mineral loss, are secondary to mechanisms maintaining sodium balance, the central blood volume, and BP.\(^3\) Data from canine experiments with experimental mineralocorticoid excess, a prototype model for sodium retention, salt-sensitive hypertension, and hypercalciuria, showed that renal perfusion pressure significantly contributed to hypercalciuria.\(^4\) This finding supported the hypothesis that hypertension, sodium homeostasis, and calcium balance are linked via pressure natriuresis. However deoxycorticosterone administration also leads to an initial increase in calciuresis that occurs before the secondary mechanisms that over-ride the mineralocorticoid action by increasing distal tubular sodium chloride delivery.\(^4\) Such an initial hypercalciuria is not explained by the central blood volume hypothesis. Furthermore there are striking differences between total body sodium and calcium balance. While more than 80% of our sodium intake is excreted by the kidney, about 80% of the dietary calcium is lost with stool, and more than 98% of the total body calcium is located in bone tissue. In contrast to sodium balance, the kidney is therefore not the major regulator of calcium balance. Not surprisingly, data from some investigators have not corroborated the calcium leak hypothesis. Lau et al\(^5\) have shown that hypercalciuria in spontaneously hypertensive rats was secondary to increased intestinal calcium absorption. Finally, recent reports suggest that osteoclast activity is under central nervous system control and that increased sympathetic

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nerve activity may directly lead to bone mineral loss. Thus bone mineral loss and hypercalciuria could occur independent of extracellular volume changes. Such losses might be related to increased sympathetic nerve tone in individuals with hypertension. Increasing evidence suggests that there is a pathophysiologic link between hypertension and bone disease. Efforts to explain the inter-relationship between hypertension, hypercalciuria, and osteopenia should be not focused solely on the kidney.

References


