A study on the mechanism of salt-sensitive hypertension induced by deficiency of nickel, an ultratrace element

-Interraction between nickel and cyclic nucleotide-gated sodium channel-

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Summary

Although there are circumstantial evidences that nickel is essential for higher animals, the physiological function of nickel is not clarified. Gordon and Zagotta (1995) found that nickel modulates the function of cyclic nucleotide-gated cation channels (CNG) *in vitro*. Nickel stabilizes the open status of rod-type CNG and the closed status of olfactory-type CNG. Yokoi et al (2003) found that nickel deprivation in rats caused decreased sperm number and motility in epididymides, shortened epididymal transit time of spermatozoa, and decreased weights of prostates and seminal vesicles. This prompted us to test the hypothesis that nickel has an important role in CNG functions *in vivo*. Therefore, we tested effect of nickel deficiency on physiological functions that relate to CNG, i.e., blood pressure regulation, natriuresis and brightness discrimination. Thirty-two three-week-old male Sprague-Dawley rats were divided into 4 groups of 8 assigned to the 16-week 2 x 2 factorially arranged experiment. The treatments were supplemental dietary nickel of 0 and 1 mg/kg and supplemental dietary sodium chloride (NaCl) at 0 and 80 g/kg. Dietary nickel deficiency elevated systolic blood pressure. In the rats fed nickel-deficient, NaCl-excessive diet, urinary excretion of albumin and N-acetyl glucosaminidase was significantly increased. Urinary sodium/creatinine ratio after oral NaCl load was significantly decreased in nickel-deficient rats. Nickel deficiency caused loss of brightness discrimination at 10 lux. These results suggest that nickel deficiency evokes hypertension with impaired natriuresis and impaired retinal photoreception, probably through the impaired CNG function.