Renal Tubular Acidosis, Vanadium and Buffaloes

V.		Sitprija ^a
K.		Tungsanga ^a
S.		Eiam-Ong ^a
N.		Leelhaphunt ^b
P.		Sriboonlue ^c

^aDepartment of Medicine, Chulalongkorn University Hospital and ^bOffice of Atomic Energy for Peace, Bangkok, and ^cDepartment of Biochemistry, Khon Kaen University, Khon Kaen, Thailand

V. Sitprija, MD, Chief, Division of Nephrology, Chulalongkorn University, Faculty of Medicine, Rama 4 Road, Bangkok 10500 (Thailand)

Dear Sir,

Geographical nephrology can be interesting when viewed in the light of the environment. Distal renal tubular acidosis is common in the Northeastern part of Thailand, representing one of the national health problems. The disease is often seen in summer among the people of low socioeconomic status with female preponderance [1]. Whether this is due to genetic variation or environmental effects remains to be worked out.

Gastric hypoacidity has been shown in patients with distal renal tubular acidosis [2], and distal renal tubular acidosis was assumed to be a generalized disease with defect in hydrogen ion transport in both renal tubules and gastric parietal cells. The defect may reside in K^+/H^+ ATPase, an enzyme which is inhibited by omeprazole and vanadium and stimulated by potassium depletion. Decreased urinary acidification has been shown after omeprazole administration in rabbits on low potassium diet [3]. Yet, omeprazole given to man with normal serum potassium did not alter urinary acidification [4].

Northeastern Thailand is the area known to have high vanadium content. The soil in this region displays the characteristics of the earth's crust in the mesozoic era. The data on soil and well water vanadium from various locations recently obtained by our group and the Department of Mineral Resources, Ministry of Industry of Thailand are shown in table 1. Neutron activation analysis technique was used in vanadium determination. Vanadium was also present in the urine of 30% of the people studied. Since there is a tendency to the development of potassium depletion during heat exposure in summer [5], inhibition of K^+/H^+ ATPase in the renal tubules by vanadium is a possibility. This may explain the common

Table 1. Vanadium in the village soil and water and the urine of the village people in Northeastern Thailand

Range Mean $\pm$ SD

Soil vanadium, $\mu\text{g/g}$ 1 13.4–332.6 64.8 $\pm$ 46.6

Well water vanadium, $\mu\text{g/l}$ 0.14–9.98 1.09 $\pm$ 2.01

Urine vanadium, $\mu\text{g/day}$ 6.74–14.00 9.49 $\pm$ 3.21

1 From the Department of Mineral Resources, Ministry of Industry of Thailand.

occurrence of renal tubular acidosis in summer, while the disease may be relatively asymptomatic during the other seasons when there is no potassium depletion. The condition thus resembles that of potassium-depleted rabbits on omeprazole.

Incidentally, buffaloes in Northeastern Thailand also exhibit muscular weakness, hypokalemia and increased urine pH in summer [6]. The animals respond well to potassium administration. This is interpreted to be a heat stress reaction especially in animals with poor development of sweat glands such as buffaloes. It is not known whether or not they have urinary acidification defect. Although the cause-effect relationship between vanadium and distal renal tubular acidosis in man has not been shown, the facts presented above are stimulating and would point to the possible role of the environment in the pathogenesis of the disease. Could renal tubular acidosis in Northeastern Thailand be a form of heat stress in the vanadium-rich environment? This jigsaw puzzle is most challenging.

Sitprija/Tungsanga/Eiam-Ong/Leelaphunt/Sriboonlue

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