Reduced Number of Erythrocyte Sodium Pump Units in Essential Hypertension

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TAKAYAMA, Y., SUZUKI, K., SEKI, A., YAMAOKI, K. and FUJII, J. Reduced Number of Erythrocyte Sodium Pump Units in Essential Hypertension. Tohoku J. exp. Med., 1984, 143 (3), 383-384 — The number of sodium pump units of erythrocytes measured with ouabain binding assay was significantly lower in 17 patients with essential hypertension (0.538 ± 0.020 pmol/10⁹ cells) than in 13 normotensive controls (0.673 ± 0.031 pmol/10⁹ cells) (p <0.01) and it was inversely correlated with erythrocyte sodium concentration (r = -0.86, p <0.01). —

hypertension ; Na-K-ATPase ; ouabain ; sodium pump

Since Garay and Meyer (1979) pointed out abnormalities of cation transport of erythrocytes in hypertensive patients, studies on these issues have provided controversial results. According to recent studies, the net sodium efflux was decreased associated with diminished sodium-potassium-ATPase (Na-K-ATPase) activity (Walter 1982) or increased associated with normal Na-K-ATPase activity (Cole 1983). We examined the number of Na-K-ATPase (sodium pump) units of erythrocytes in patients with essential hypertension with ouabain binding assay.

Material and Methods. The number of Na-K-ATPase units of erythrocytes was measured with the method of De Luise et al. (1980) with a minor modification (Suzuki et al. 1983) in 17 non-obese untreated patients with essential hypertension (10 males and 7 females; average age of 54.4 years) and 13 non-obese normotensive healthy controls (8 males and 5 females; average age of 53.7 years). Erythrocytes prepared from heparinized blood by the use of Ficoll-Paque were washed two times with assay buffer and the final cell concentration was about 20%. 200 μl aliquots of the cell suspension with 0.5 pmol of ³H-ouabain and cold ouabain (0 to 1,000 μM) were incubated for 180 min at 37°C. The radioactivity associated with cell pellets was eluted with 5% trichloroacetic acid and was counted in a liquid scintillation counter. Maximal ouabain binding capacity was calculated as described by De Luise et al. (1980). Erythrocyte sodium and potassium concentrations were measured in 5 hypertensive and 4 normotensive persons. A 200 μl of whole blood was aliquoted into a Microfuge tube containing 1 ml of 140 mM choline chloride and 200 μl of dibutyl phthalate. The tube was then centrifuged in a Beckman Microfuge for 5 min at 10,000 ×g. The solution and dibutyl phthalate layers were aspirated. Fifty

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microliters of packed cells were then lysed in a 5 ml of hypotonic lithium chloride solution, and the concentration of sodium and potassium were determined with a flame photometer.

Results. Fig. 1 shows individual values for maximal ouabain binding capacity which represents the number of Na-K-ATPase units of erythrocytes in hypertensive and normotensive groups. The mean value was $0.538 \pm 0.020$ (s.e.) pmol/10⁹ cells for the hypertensives which was significantly lower than $0.673 \pm 0.031$ pmol/10⁹ cells for the normotensives ($p < 0.01$), although an overlap existed. Fig. 2 shows relationship between maximal ouabain binding capacity and erythrocyte sodium concentration. A significant inverse correlation existed despite a small number of samples ($r = -0.86$, $p < 0.01$). No correlation was observed between maximal ouabain binding capacity and erythrocyte potassium concentration.

Comments. The present study demonstrated that the number of Na-K-ATPase units of erythrocytes was decreased in essential hypertension. The presence of an inverse correlation between the number of Na-K-ATPase units and erythrocyte sodium concentration indicates that the changes in the number of Na-K-ATPase units play a primary role in controlling the intracellular sodium concentration. The decrease in the number of Na-K-ATPase units of erythrocytes is not specific for essential hypertension. The same changes were observed in obese patients by De Luise et al. (1980) and in patients with hyperthyroidism by Suzuki et al. (1983).

Fig. 1 (left). Maximal ouabain binding capacity of erythrocytes in hypertensives and normotensives. Bar denotes mean value.
Fig. 2 (right). Correlation between maximal ouabain binding capacity and erythrocyte sodium concentration.

References