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RAPID COMMUNICATION

Na^+/H^+ Exchange in Erythrocytes of Spontaneously Hypertensive Rats: A Study in F_2 SHR x WKY Hybrids

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Summary

The rate of proton gradient-induced Na^+/H^+ exchange in the erythrocytes of SHR was increased by 50-60 % as compared to WKY animals. No significant correlation between Na^+/H^+ exchange and blood pressure was revealed in F_2 hybrids of SHR and WKY rats. Na^+/H^+ exchange rate in the erythrocytes of F_2 SHR x WKY hybrids was twice as high as in SHR and three times higher than in WKY rats.

Key words
Spontaneous hypertension – Erythrocytes – F_2 hybrids – Na^+/H^+ exchange

It was shown previously that Na^+/H^+ exchange induced by cell shrinkage or cytoplasm acidification is increased 1.5–2 times in SHR as compared to WKY erythrocytes (Orlov *et al.* 1987, 1989). Similar elevation of Na^+/H^+ exchange was also observed in platelets, lymphocytes and smooth muscle cells of SHR (Feig 1987, Feig *et al.* 1987, E & Deth 1988, Markov *et al.* 1989). To study the involvement of this phenomenon in the pathogenesis of spontaneous hypertension we examined the Na^+/H^+ exchange in erythrocytes of F_2 hybrids of SHR and WKY rats.

Five-month-old male SHR rats with systolic blood pressure (SBP) of 175±7 mm Hg, age-matched WKY male rats with SBP of 112±5 mm Hg and four-month-old F_2 hybrids of SHR and WKY rats were used. Blood pressure was measured in conscious animals through a catheterized femoral artery. The rate of electrochemical proton gradient-induced Na^+/H^+ exchange was measured as the value of amiloride-inhibited proton efflux at intracellular pH 6.60–6.70 and extracellular pH 7.95–8.05 (Orlov *et al.* 1989).

The rate of proton gradient-induced Na^+/H^+ exchange in erythrocytes of SHR was increased by 50–60% as compared with WKY rats (Table 1).

Table 1
Amiloride-inhibited (Na^+/H^+ exchange) and amiloride-nonsensitive components of proton efflux in erythrocytes of spontaneously hypertensive (SHR), normotensive (WKY) rats and F_2 SHR x WKY hybrids

Groups	n	Amiloride-inhibited component	Amiloride-nonsensitive component
		mmol . (l cells . h)$^{-1}$	
1. WKY	11	10.54 ± 1.58	8.90 ± 2.88
2. SHR	13	17.77 ± 1.84	25.80 ± 2.88
3. F_2 hybrids	28	31.60 ± 2.55	29.40 ± 2.74
$P_{1,2}$		< 0.01	N.S.
$P_{1,3}$		< 0.001	< 0.001
$P_{2,3}$		< 0.001	N.S.

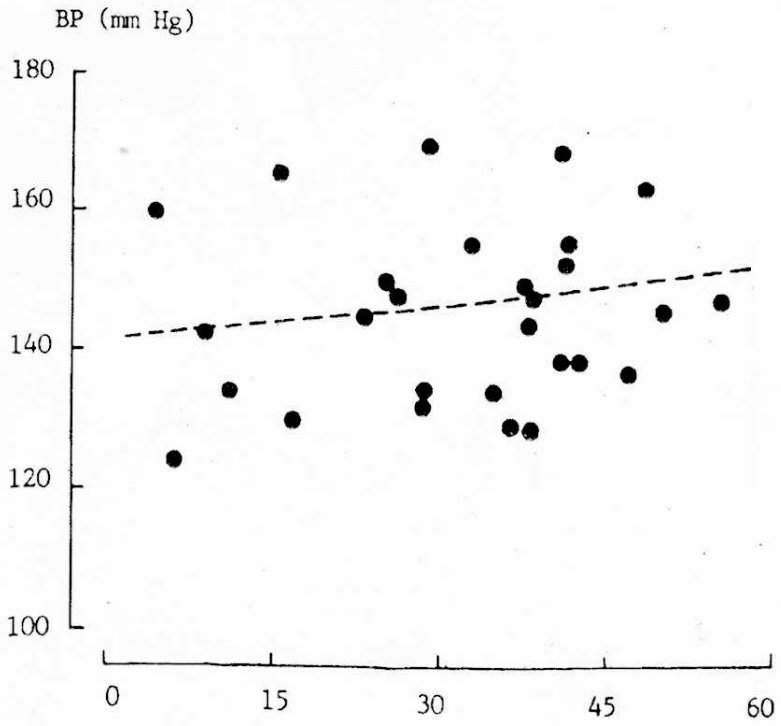

Fig. 1
The relationship of systolic blood pressure and Na^+/H^+ exchange rate [mmol . (l cells . h)$^{-1}$] in erythrocytes of F_2 SHR x WKY hybrids (n = 28, r = 0.07, n.s.).

This is in accordance with our previous data (Orlov *et al.* 1989). The amiloride-nonsensitive component of proton efflux rate was 25–35% greater in SHR than in WKY erythrocytes. This could be due to incomplete inhibition of Na^+/H^+ exchange by this substance as was recently shown in the study of proton gradient-induced Na^+/H^+ exchange in human red cells (Semplicini *et al.* 1989a). It is evident from Tab. 1 that the rate of Na^+/H^+ exchange in erythrocytes of F_2 hybrids was twice as high as in SHR and three times greater than in WKY rats. There was no significant correlation between blood pressure and Na^+/H^+ exchange rate in F_2 SHR x WKY hybrids (Fig. 1).

The hypothesis on the involvement of Na^+/H^+ exchange in the pathogenesis of primary hypertension was formulated by Aviv (1988) and Postnov *et al.* (1988). In addition to the above mentioned studies this suggestion is further supported by the findings of increased Na^+/H^+ exchange in platelets (Livne *et al.* 1987) and red cells of patients with essential hypertension (Orlov *et al.* 1988, 1989, Semplicini *et al.* 1989b). However, some data contradict this hypothesis. Thus we failed to reveal any alterations of Na^+/H^+ exchange in the rats of Milan hypertensive strain (Orlov *et al.* 1989). It was further found that the rate of Na^+/H^+ exchange in erythrocytes of the normotensive Brown Norway strain (BN.lx rats) was also elevated above the level observed in SHR (Orlov *et al.* 1991). The present data clearly demonstrate the absence of any significant correlation between blood pressure and Na^+/H^+ exchange in F_2 hybrids in which the rate of Na^+/H^+ exchange was greater than in both progenitor strains, i.e. SHR and WKY. At present there is no satisfactory explanation for this phenomenon.

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