

Alterations in ^{22}Na fluxes of arterial smooth muscles of spontaneously hypertensive rats

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The rats obtained in 1963 by Okamoto & Aoki are spontaneously hypertensive (SH rats). These SH rats present an increase in vascular resistance which seems to be associated with an altered reactivity of vascular smooth muscle (Hausler & Finch, 1972) which could be due to changes in excitation or excitation-contraction coupling processes. Jones (1973, 1974) has observed an increased K^+ and Na^+ turnover. In order to confirm these findings we have analyzed Na^+ turnover from tail arteries obtained from male SH and normotensive Wistar (NW) rats of the same age which have been used as controls. ^{22}Na fluxes have been studied after equilibration of intracellular and extracellular specific activities by incubating the arteries for 90 min at 35°C gassed with 95% O_2 and 5% CO_2 in a physiological solution containing the tracer and having the following composition (mM): NaCl 120.8, KCl 5.9, CaCl_2 1.5, MgCl_2 1.2, NaHCO_3 15.5, NaH_2PO_4 1.2 and glucose 11.5. Effluxes were performed using a superfusion technique (Hamon, Papadimitriou & Worcel, 1976) at 35°C . The efflux

curve can be separated into a series of exponential components among which the intermediary Be^{-k_2t} corresponds to the membrane limited efflux from the smooth muscle cells (Garay, Moura & Worcel, unpublished observations). ^{22}Na efflux rate k_2 was increased in 8 weeks old SH rats as well as the smooth muscle cell Na^+ compartment B (Table 1). The efflux rate becomes normal at 12 and 20 weeks SH rats. The compartment B is normal at 12 weeks and smaller than in controls at 20 weeks. The action of ouabain on ^{22}Na efflux rate k_2 was studied on arteries from 8 weeks old rats in order to quantify its effects on the Na^+ pump and to distinguish between ouabain sensitive and insensitive fractions of ^{22}Na efflux.

From these experiments we could determine that ouabain sensitive efflux in completely blocked muscles is identical in NW (0.106 min^{-1}) and SH rats (0.099 min^{-1}). According to these values, it appears that the ouabain insensitive fraction is greatly increased (+63%) in SH (0.067 min^{-1}) as opposed to NW rats (0.041 min^{-1}). Surprisingly the K_m constants for ouabain action on the Na^+ pump have been found to be different: $K_{\text{SH}} = 3.3 \times 10^{-4} \text{ M}$ and $K_{\text{NW}} = 7.6 \times 10^{-4} \text{ M}$.

In conclusion at an early stage of development of hypertension there is an increase in ouabain insensitive, membrane limited ^{22}Na efflux from arterial smooth muscle cells. This is accompanied by an increased Na^+ content in the cellular compartment and an alteration in the sensitivity of the Na^+ pump to ouabain which is difficult to interpret at the moment.

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Table 1 ^{22}Na efflux from arterial smooth muscle cells of NW and SH rats

Age	8 Weeks		12 Weeks		20 Weeks	
	NW	SH	NW	SH	NW	SH
k_2 (min^{-1})	$0.144 \pm 0.005(1)$	$0.173^* \pm 0.012$	0.145 ± 0.004	0.153 ± 0.004	0.139 ± 0.003	0.143 ± 0.004
B (mmol/kg wet weight)	2.7 ± 0.09	3.1 $^* \pm 0.12$	3.0 ± 0.15	2.9 ± 0.16	3.2 ± 0.17	2.5** ± 0.14
n	7	6	7	9	10	11

(1) mean \pm s.e. mean; * $P < 0.05$; ** $P < 0.01$.

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