Working Group on Childhood Hypertension—WGCH

Lectures

Erythrocyte Cation Fluxes as Tracers of Essential Hypertension

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During the last four years, we have done more than 400 determinations of erythrocyte cation fluxes. The main purpose of our project was to identify by a simple venipuncture the young children at risk of future essential hypertension and subsequent cardiovascular risks. Since the original studies of Garay (3) and Canessa (1) several groups of researchers have established that in essential hypertension, four subgroups of patients could be identified according to their pattern of erythrocyte cation fluxes: they could present either an increase in Na-Lithium countertransport, a decrease in Na-K cotransport, a passive Na⁺ leak, or have normal fluxes.

Unfortunately, very few groups interested in this topic tried to relate these various cation fluxes abnormalities to the clinical subgroups of essential hypertension.

As a first step to identify a "tracer" of essential hypertension, the present study tries to relate the abnormality of erythrocyte cation fluxes to the various clinical subgroups of essential hypertensive children and adolescents.

In this study, erythrocyte cation fluxes were determined in fresh cells according to the technique of Garay (4). When these fluxes were found to be normal, Na-K cotransport system was stimulated by PCMBs and Na loading according to the technique of Garay (4) in order to obtain the affinity of the system for intracellular sodium. Patients were then classified in one of the subgroups mentioned above.

MATERIAL:

Seventy-one patients, age 2 to 19, were defined as suffering from essential hypertension according to criteria described before (5). All these children had at least two separate determinations of cation fluxes.

Clinically, the severity of hypertension was identified as stable if blood pressure was always found to be above the 95th percentile for age and sex, and labile if some of the blood pressure readings were above and some other below the 95th percentile. The blood pressure of the parents was measured by our staff. The clinical criteria evaluated were age, sex, overweight, parental hypertension, and plasma catecholamines.

Moreover, in a selected group of 40 patients, echocardiography was performed as described before (2) and mean arterial pressure, cardiac index, peripheral resistance and all parameters about the function of the left ventricle were assessed.

RESULTS:

From the 71 patients, 14 (20%) were found to have a high Na-Li countertransport, 11 (15%) a decreased Na-K furosemide sensitive cotransport, 22 (31%) an increased Na⁺ passive permeability and 24 (34%) had normal erythrocyte fluxes.

The clinical features of each subgroup of cation fluxes are shown below:

CLINICAL CORRELATIONS

	AGE	ELEVATED PLASMA CATECHOLAMINES	SEVERITY
High countertransport n = 14	11.5	3/13	stable 10 labile 4
Low cotransport n = 11	12.5	4/7	stable 2 labile 9
Na ⁺ leak n = 22	14.2	8/17	stable 6 labile 16
Normal fluxes n = 24	13.5	4/19	stable 19 labile 15

The M/F ratio was 1.5 overall and in every subgroup. The patients with an elevated countertransport were younger (av. 11.5

years) than the ones in other subgroups. Overweight was equally found in every subgroup. Parental hypertension was encountered in every subgroup, but was more frequent in patients presenting an increased Na⁺ leak (16/22). The subgroup with an elevated countertransport was also more severely hypertensive: 10/14 patients had a stable type of hypertension. This incidence of stable hypertension contrasts with the 2/11 found in the patients with low cotransport and the 6/22 of the Na⁺ leak subgroup, but is similar to the 19/34 incidence of stable hypertension encountered in the subgroup with normal fluxes.

The incidence of the elevation of plasma norepinephrine and/or epinephrine was greater in the subgroup of patients with decreased cotransport (4/7) than in any other subgroup.

The results of the hemodynamic studies showed that the subgroup with elevated countertransport had greater mean arterial pressure, total peripheral resistance and signs of left ventricular overwork than any of the other subgroups.

In conclusion, the patients with an elevated countertransport were younger and more severely hypertensive than the others. The ones with decreased cotransport had a labile type of hypertension with elevated plasma catecholamines. The patients with a Na⁺ leak had mild hypertension with a familial tendency toward hypertension. Finally, the subgroup with normal fluxes seems to be heterogeneous.

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Hypertension in the Neonate

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Blood pressure (BP) is low at birth. It increases with age, by about 1 mm Hg per day within the period of 3 to 8 days. It rises by about 1 mm Hg per week between ages 5 to 6 weeks. There is a significant relationship between BP at age 5 days and BP at age 6 weeks. At the latter age, systolic BP is close to 95±10 mm Hg.

Hypertension is a rare condition in the neonate. It carries a high risk of cardiorespiratory failure and cerebral distress. Causes of neonatal hypertension are either secondary to congenital malformations or to acquired disease states:

Congenital malformations: renal artery stenosis, renal artery hypoplasia, abdominal aortic atresia, coarctation of the aorta, kidney cystic disease, reflux nephropathies.

Acquired diseases: thrombo-embolic renal artery complications secondary to umbilical artery catheterization or to thrombosis of ductus arteriosus, closure of abdominal wall defects, adrenal hematoma with renal artery compression, seizures in preterm infants, central nervous system disorders, drug-induced hypertension, infants of drug dependent mothers.

Prognosis: the morbidity and the mortality of neonatal hypertension are elevated. Death may be caused by severe uncontrollable hypertension or by concomitant problems. Morbidity may be related to drug-resistant hypertension, or to the side effects of the drugs. Surgery in these severely ill infants also carries a significant risk.