A TWIN STUDY OF CYTOGENETIC VARIABILITY

Progress Report *

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The preliminary results of a cytogenetic analysis of blast index, mitotic index and association index, as well as of morphological indices of chromosomes 1, 9 and 16, carried out on two subsamples of twin pairs of different age groups, seem to indicate that the genetic material may undergo some process of transformation with time.

Cytogenetics being such a young branch of science, still mainly devoted to the study of genetic diseases, it hardly could deal yet with the contribution it may gain from twin studies in physiological conditions.

The latter subject is being investigated from various angles by researchers at the Mendel Institute in Rome; the present paper reports our preliminary findings on normal karyotype variability and on the genetic significance of data obtained from twin studies.

Our study is based on the analysis of the karyotype from peripheral lymphocytes in 24 twin pairs: 6 MZ and 6 DZ pairs in the 6-to-8 year age group, and as many again in the 16-to-18 year age group, male and female pairs being equally represented. Lymphocytes were treated by standard laboratory techniques, producing both normal and-G-banded karyograms. The resulting material provides two sets of data:

(1) Data concerning blast index, mitotic index and the measure of acrocentric association in either age group;

(2) Data concerning the centromeric index in three autosomes (chromosomes 1, 9 and 16) again in either age group.

The two sets of data were considered separately because the former is functionally related to age variations in the dynamics of induced mitosis in lymphocytes, while the centromeric index, as calculated in three autosomes, essentially represents a test of the stability of chromosome morphology in the same chronological dimension.

The good health of our subjects had been verified by clinical examination supplemented by lab tests (blood counts, sedimentation rate, antistreptolysine titration).

Our findings concerning the three parameters of lymphocyte dynamic reactivity following PHA stimulation seem to indicate:

(1) That the three parameters become modified with age (the blast index decreases from 19.4 to 15.7%; the mitotic index increases from 3.8 to 5.0%; the association index increases from 20.5 to 26.5%);

(2) That lymphocyte response to mitogenic stimulation becomes modified with age, tending to a deceleration of mitotic processes. Direct evidence of such decay is provided by the lower number of reacting cells, while indirect indication comes from the lengthening of the various phases of mitosis, as evidenced by the increase in the number of dividing cells remaining in metaphase. The increase in the number of acrocentric asso-

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Table 1. *Functional indices of mitosis: Intrapair correlation and heritability values in twin pairs of two age groups*

Age group		Blast index		Mitotic index		Association index	
6-8 yr	rMZ	0.90		0.47		0.58	
	rDZ	0.53		0.33		0.63	
	h^2		0.74		0.28		~0.0
16-18 yr	rMZ	0.71		0.38		0.53	
	rDZ	0.53		0.41		0.51	
	h^2		0.36		~0.0		~0.0

Table 2. *Variability of centromeric index according to zygosity sex and age group*

Chromosome	Comparison	$\overline{X}_1$	S_1	$\overline{X}_2$	S_2	t	p
1	MZ vs. DZ	46.80	0.81	46.95	0.93	—0.420	ns
	Males vs. Females	47.65	1.56	47.14	1.21	1.243	ns
	Age I vs. Age II	46.87	0.86	47.90	1.64	—2.726	≃0.010
9	MZ vs. DZ	34.74	2.87	34.55	2.56	0.245	ns
	Males vs. Females	33.90	2.69	35.38	2.51	—1.965	ns
	Age I vs. Age II	33.58	2.56	35.83	2.45	—3.140	≃0.005
16	MZ vs. DZ	38.25	3.55	37.17	2.45	1.214	ns
	Males vs. Females	37.68	3.68	37.77	2.33	—0.092	ns
	Age I vs. Age II	36.74	2.00	38.71	3.60	—2.342	≃0.025

ciations (a phenomenon related to non-disjunction) seems to confirm the finding of an overall decay in the efficiency of mitotic processes.

The heretability estimates (Table 1) show that:

(1) Genetic conditioning is reflected only in the number of stimulus-responding lymphocytes (blast index);

(2) Genetic conditioning in the response to mitogenic stimulation varies with age, seemingly indicating a variation in the efficiency of the genotype.

Table 2 summarizes our findings concerning the centromeric index $\left(\frac{p}{p+q}\right)$ in chromosomes 1, 9 and 16; these autosomes were chosen it being already known that they exhibit a high degree of "normal" variability. The resulting data are analyzed on the basis of mean values in the various classes of zygosity, sex and age. The comparison between means, as evicenced by t values, indicates that no significant differences as to centromeric index were found between either zygosity classes or sexes, while significant differences were found between age groups for all three autosomes.

Our analysis indicates that:

(1) The normal morphology of chromosomes 1, 9 and 16 becomes significantly modified over the decade going from 6-8 to 16-18 years of age, the long arm becoming relatively shorter;

(2) The morphological change seems to be related to a reduction of the first (heterochromatic) band in the long arm.

In conclusion, the analysis of functional indices of mitosis seem to indicate the existence of a chronogenetic transformation of the genetic material, while the analysis of morphological indices in the three autosomes suggests the existence of a chronological transformation whose predominantly genetic or environmental nature remains to be clarified.

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