Random Association of Human Acrocentric Chromosomes

MARGERY W. SHAW, ANN P. CRAIG, AND FLORENCE C. RICCIUTI[1]

According to a committee report of the last conference on human chromosome nomenclature (Chicago Conference 1966), the D group chromosomes may be differentiated by their labeling patterns if dividing cells are exposed to tritiated thymidine during the terminal stages of DNA synthesis. Heavy label is shown in D13 in the middle and distal portions of the long arms, while D14 has a concentration of grains in the short arms, centromere, and proximal region of the long arms, and D15 completes replication earlier than the other two pairs.

Hecht et al. (1968) have reported that among 33 sporadic and familial D/G translocations, 30 involved the D14 chromosome and the remaining three were D15. Since acrocentric chromosomes tend to associate in rosette formation in metaphase spreads, Ohno et al. (1961) have postulated that translocations among the acrocentric chromosomes occur as a result of this close association. It occurred to us to examine acrocentric associations in labeled metaphase cells to determine whether D/G associations involve D14 more frequently than D13 or D15. If such is the case, one might also expect to find D13 and D14 more often associated with each other, since Bloom and Gerald (1967) have shown a preponderance of 13/14 in D/D translocations.

We examined autoradiographs of metaphase cells derived from lymphocyte cultures of a healthy female. These cultures were exposed to tritiated thymidine continuously during the final 1–7 hr of the culture period and received colcemid 3 hr prior to harvest. A total of 67 cells were judged to have been labeled in the late S period. Of these, 10 cells had no acrocentric associations and 21 cells had uninformative labeling. The remaining 36 cells were found to have acrocentric chromosomes in association and a grain distribution consistent with the Chicago criteria. The results of the autoradiography analysis are given in table 1. We did not attempt to differentiate G21 and G22 because of inconsistent labeling patterns for group G (Back et al. 1967).

Table 2 shows that there is an entirely random pattern of D chromosome associations in this one subject. However, these findings do not preclude the possibility that there is individual variability in the patterns of acrocentric associations. The finding of such polymorphism would raise the question of nonrandom patterns of associations occurring in certain individuals, such as those who are predisposed to acrocentric nondisjunction and/or acrocentric translocation.

Received May 20, 1969

Supported by U.S. Public Health Service research grant GM 15361 from the National Institutes of Health.

[1] Department of Biology, The University of Texas M. D. Anderson Hospital and Tumor Institute, Houston, Texas 77025.

SUMMARY

Cultured lymphocytes from a female were labeled with tritiated thymidine. Thirty-six cells were labeled in the late S period and also had acrocentric chromosomes in association. Analysis of these associations showed the D group chromosomes to be randomly involved, both in D/D associations and in D/G associations.

TABLE 1

ASSOCIATIONS IN 36 CELLS CLASSIFIED ACCORDING TO COHEN AND SHAW (1967)

Cell Type	Number of Cells	D Chromosomes Involved in the Associations*
D^2	1	13-15
DG	6	(4)13; (2)14
G^2	2	
D^2G	1	13-15
$2D^2$	2	(2)13-15+14-15
D^2+DG	3	13-15+14; 13-15+15; 14-15+13
D^2+G^2	1	13-14
2DG	4	13+13; 13+14; 13+15; 14+15
$DG+G^2$	1	14
D^3+G^2	1	13-15-15
D^2G+DG	1	14-15+14
DG^2+DG	2	13+13; 14+15
G^3+DG	1	13
D^3+DG^2	1	13-14-15+15
$2D^2G$	1	13-14+14-15
$2D^2+DG$	2	(2)13-15+14-14+15
D^2+2DG	1	15-15+13+14
D^2+DG+G^2	3	(2)13-14+15; 13-15+13
$D^2G+DG+G^2$	1	14-14+15
$2D^2G+DG$	1	13-13+14-15+14
Total	36	

* Numbers in parentheses refer to number of cells of each type. Different cell types are separated by a semicolon.

TABLE 2

FREQUENCY OF PARTICIPATION OF CHROMOSOME NOS. 13, 14, AND 15 IN VARIOUS ASSOCIATIONS

	No. 13	No. 14	No. 15
DG	13	9	9
D^2G	4	6	4
DG^2	1	1	1
D^2	11	10	13
D^3	2	1	3
Associations of D and G (DG, D^2G, and DG^2)	18	16	14
Associations of D only (D^2 and D^3)	13	11	16
Total associations	31	27	30

REFERENCES

BACK, F.; DORMER, P.; BAUMANN, P.; and OLBRICH, E. 1967. Trisomy 21 or 22 in Down's syndrome? *Lancet* **1**:1228.

BLOOM, G. E., and GERALD, P. S. 1967. Autoradiographic studies of D chromosomes. *Annual meeting of the American Society of Human Genetics*, Toronto, December 1–3, 1967. (Abstr.)

Chicago Conference: Standardization in Human Cytogenetics. 1966. Birth defects: Original article Ser. 2:10 (Append. A). National Foundation, New York.

COHEN, M. M., and SHAW, M. W. 1967. The association of acrocentric chromosomes in 1000 normal human male metaphase cells. *Ann. Hum. Genet.* **31**:129–140.

HECHT, F.; CASE, M. P.; LOVRIEN, E. W.; HIGGINS, J. V.; THULINE, H. C.; and MELNYK, J. 1968. Nonrandomness of translocations in man: preferential entry of chromosomes into 13–15/21 translocations. *Science* **161**:371–372.

OHNO, S.; TRUJILLO, J. M.; KAPLAN, W. D.; and KINOSITA, R. 1961. Nucleolus-organisers in the causation of chromosomal anomalies in man. *Lancet* **2**:123–125.