EFFICIENCY IN DISPUTED PATERNITY CASES OF A NEW CATEGORY OF MARKERS : CHROMOSOME VARIANTS.

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SUMMARY

Using suitable cytogenetic techniques, chromosome polymorphism has been studied in eighty disputed paternity cases.

Based on the Belgian frequencies, the theoretical rate of exclusion is 88.2 % when a girl and 95 % when a boy. Thus chromosome variants added to 22 blood group systems increase the exclusion rate from 99.7 % to 99.96 and 99.98 %.

In case of exclusion, the mean number of involved systems increased from 4 to 5.

In cases without exclusion, the probability of paternity was often high and, in some cases, the paternity was almost certain.

INTRODUCTION

For controverted paternity cases, erythrocyte, enzymatic and plasmatic blood groups are used. Some laboratories are using the HLA system which gives very good results.

A new polymorphism - completely differing from those known until now - was lately described : chromosome variants (1, 2). These variants are observed by using cytogenetic techniques which reveal variable constitutive heterochromatin regions of human metaphase chromosomes.

These heterochromatin regions are supposed to represent highly repetitive DNA, thought to be genetically inert (3). Clinical abnormalities have not yet been correlated with such variations (4). These variants mainly concern the chromosomes described in Table I.

CHROMOSOME	REGION	VARIANT
1, 9, 16 7, 19	SUBCENTROMERIC HETEROCHROMATIN CENTROMERIC HETEROCHROMATIN	LENGTH VARIATION AND PERICENTRIC INVERSION
3, 4	CENTROMERE	INTENSITY VARIATION
D : 13, 14, 15 G : 21, 22	CENTROMERE SHORT ARMS SATELLITES	INTENSITY VARIATION LENGTH VARIATION INTENSITY VARIATION
Y	DISTAL HETEROCHROMATIN	LENGTH VARIATION

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MATERIAL AND METHODS

Our study was based on a sample of eighty paternity cases between 1980 and 1984 (73 trios "man-mother-child", 5 cases with 2 alleged fathers and 2 cases with 2 children).

The blood groups analysis concerned 7 erythrocyte systems, 14 protein systems and HLA-A, B.

The metaphase chromosomes were obtained by a 72 hours lymphocyte cell culture (5). We systematically used 3 types of banding :
G-banding (GAG) Q-banding (QFQ) C-banding (CBG)

THEORETICAL PROBABILITY OF EXCLUSION

Based on the Belgian frequencies, the theoretical rate, under which paternity exclusion may be obtained, has been calculated for each chromosome according to OHNO et al. (6) (Table II).

CHROMOSOME	REGION	NUMBER OF VARIANTS	THEORITICAL PROBABILITY OF EXCLUSION
1	qh	6	22.5 %
3	c	4	19.3 %
4	c	2	0.6 %
7	c	4	12 %
9	qh	6	28.5 %
13	cent-sat.	10	19.8 %
14	cent-sat.	6	11.1 %
15	cent-sat.	6	8.8 %
16	qh	7	16.5 %
19	c	4	19.9 %
21	sat.	4	18 %
22	sat.	4	15.6 %
y	qh	5	57.3 %
	TOTAL	GIRLS :	88.2 %
		BOYS :	95.0 %

The total theoretical percentage of exclusion amounts to 88 % about paternity of girls and to 95 % for boys. Added to the probability obtained with blood groups (99.7 % - (7), it respectively amounts to 99.96 % and to 99.98 %.

STUDY OF 80 CASES

According to Table III, the 80 cases were distributed in 2 groups :
- excluded men (57 men)
- non-excluded men (30 men)

		BLOOD GROUP SYSTEMS		
		EXCLUDED MEN	NON-EXCLUDED MEN	
CHROMOSOME VARIANTS	EXCLUDED MEN	45	0	45
	NON-EXCLUDED MEN	12	30	42
		57	30	

57 excluded men

The mean number of blood group systems involved in exclusion was 4. It became 5 when adding chromosome variants.

30 non-excluded men

About non-exclusion cases, two indications of paternity help to decide if the man can be considered as the father or not :
- the proportion of excluded men in the couple "mother-child"
- the probability of the *a posteriori* paternity for alleged father

We calculated these two indications for each case (Table IV).

Values	proportion of excluded men Number of couple "mother child"		probability of paternity Number of trio "man-mother-child"	
	BLOOD GROUP SYSTEMS	+ CHROMOSOME VARIANTS	BLOOD GROUP SYSTEMS	+ CHROMOSOME VARIANTS
from 98 to 99 %	1	1	0	0
from 99.0 to 99.9 %	14	2	5	2
from 99.90 to 99.99 %	11	10	15	3
from 99.990 to 99.999 %	2	7	6	9
from 99.9990 to 99.9999 %	2	3	3	7
> 99.99990 %	0	7	1	9

With the 22 blood groups and for the mean cases, the percentage of excluded men went from 99.0 % to 99.990 %, it means one non excluded man out of 100 and one non-excluded man out of 10,000; the probability of paternity went from 99.0 % to 99.9990 %, it means one case of non-paternity out of 100 and one case of non-paternity out of 100,000.

When adding chromosome variants analysis, for the mean cases, the percentage of excluded men became higher than 99.90 % and the probability of paternity went from 99.990 % to 99.99999 %, it means one case of non-paternity out of 1 million and sometimes even more.

CONCLUSION

Chromosome variants bring disputed paternity questions a sure efficacy but with the blood group systems.

Used alone, chromosome polymorphism would not have excluded :
- 1 false father out of 5 when the child is a girl,
- 1 false father out of 20 when the child is a boy.

The detection of these chromosome variants requires a great experience of cytogenetics and has to be performed in specialized laboratories (cell cultures, banding stain for example).

On the one hand, the advantage of this polymorphism is that the variant is directly visible and is not the "translation" between several stages of an "invisible" gene. There is no silent allele .So are the second order exclusions as secure as the first order exclusions.

On the other hand, this polymorphism allows a new type of exclusion which is simple and accurate : exclusion by Y chromosome. The real father and the son must have a strictly identical Y chromosome.

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