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A critical review for DNA polymorphic markers and blood group markers in paternity testing

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Abstract

We compared the probability of paternity examined using 16 DNA polymorphic markers and 20 conventional blood group markers in 50 cases of disputed paternity in our laboratory. Samples were obtained from Japanese individuals in disputed paternity casework. The calculation of paternity probability used the Essen-Moller formula and Bayes's theorem, and the probable genotypes of the deceased putative father were deduced by Komatu based on Bayes's theorem from the genotypes of the widow and the genotypes of their children. The mean paternity probability was calculated by StatView J 5.0 software. The mean probabilities of paternity confirmation thus obtained were 0.9955 and 0.9242, respectively, for 16 DNA polymorphic markers and 20 conventional blood group markers in 39 cases of confirmed paternity. The mean rates of exclusion thus obtained were 0.3655 and 0.1591, respectively, for 16 DNA polymorphic markers and 20 conventional blood group markers in 11 cases of excluded paternity.

Keywords: DNA polymorphic markers; Blood group markers; Paternity testing; Probability of paternity

1. Introduction

In recent years, genomic DNA analysis technology has shown a truly dramatic development in the area of biological research. The DNA polymorphism is widely used in areas such as criminal identification and paternity testing [1,2]. The allele frequencies and allele number of several DNA polymorphic markers were previously determined in the Japanese population with the PCR and the southern blotting technique [3–6]. These DNA polymorphic markers were also used in the Japanese population for the analysis of disputed

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Table 1
The cases of paternity testing

Paternity testing	Confirmation	Exclusion	Total
normal cases	22	8	30
father and child	1	1	2
mother and child	1	0	1
father deceased	10	1	11
half sibling	5	1	6
total	39	11	50

paternity cases and individual identification. In this study, we compared probability of paternity examined using 16 DNA polymorphic markers and 20 conventional blood group markers in 50 cases of disputed paternity in our laboratory.

2. Materials and methods

The samples were obtained from Japanese individuals in the disputed paternity casework in our laboratory (Table 1). DNA was extracted from blood samples using the phenol–chloroform method [7]. The usefulness was compared between 16 DNA polymorphic markers and 20 conventional blood group markers for paternity testing. The examination content of DNA polymorphism and blood group are shown in Table 2. The calculation of paternity probability used the Essen-Moller formula and Bayes's theorem, and the probable genotypes of the deceased putative father were deduced by Komatu based on Bayes's theorem from the genotypes of the widow and the genotypes of their children [8,9]. The mean paternity probability was calculated by StatView J 5.0 software.

3. Results

The plausibility of paternity of an alleged father was evaluated on 16 DNA polymorphic markers and 20 conventional blood group markers in 50 cases of disputed paternity. The

Table 2
The examination content

DNA polymorphism		Blood group	
D1S80	D3S1358	ABO	GC
LDLR	D5S818	MNSs	Hp
GYPA	D13S317	Rh	BF
HBGG	D13S317	Duffy	IF
D7S8	D7S820	Kidd	PLG
GC	CSF1PO	Lewis	C1R
VWA	TPOX	AcP	C2
FGA	TH01	EsD	C6
		PGM	C7
		6-PGD	HLA

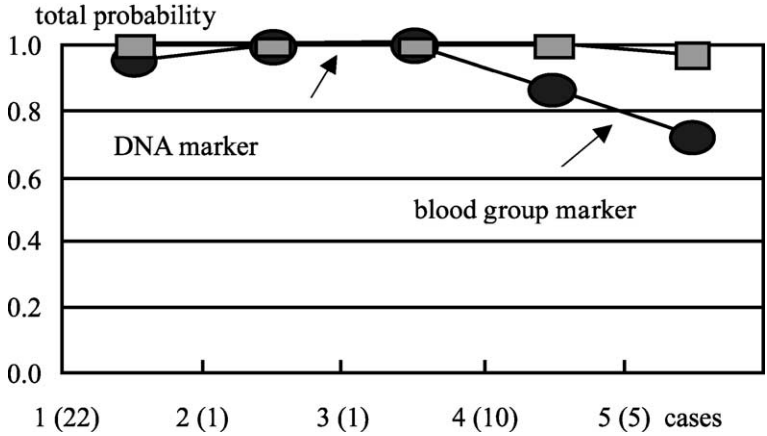

Fig. 1. Comparison of paternity probability in 39 cases of confirmatory paternity. 1: Twenty cases of normal paternity testing, 2: 1 case of alleged father and child testing, 3: 1 case of alleged mother and child testing, 4: 10 cases of alleged father deceased, 5: 5 cases of half-sibling testing.

comparison of confirmatory paternity probability is shown in Fig. 1. The mean probability of paternity confirmation thus obtained was 0.9955 for 16 DNA polymorphic markers and 0.9242 for 20 conventional blood group markers in 39 cases of confirmed paternity (Table 1). The mean rates of exclusion thus obtained were 0.3655 and 0.1591 for 16 DNA polymorphic markers and 20 conventional blood group markers in 11 cases of excluded paternity (Fig. 2). The mean probability of paternity confirmation was 0.9995 for 16 DNA polymorphic markers and 0.8624 for 20 conventional blood group markers in 10 cases of alleged father deceased (Fig. 3). The mean probabilities of paternity confirmation were

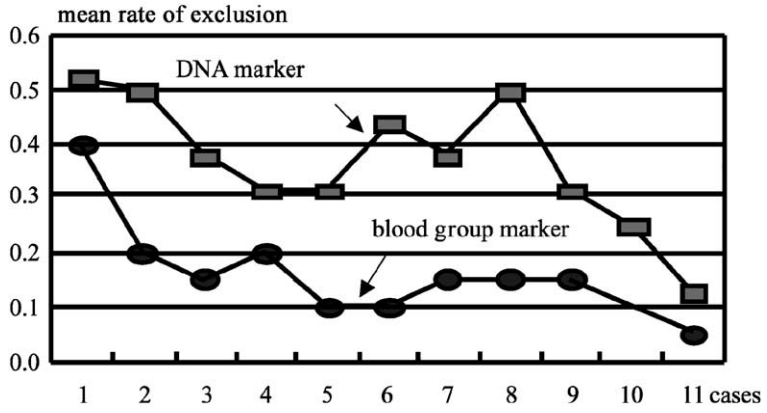

Fig. 2. Comparison of the probability of paternity exclusion in 11 cases of excluded paternity.

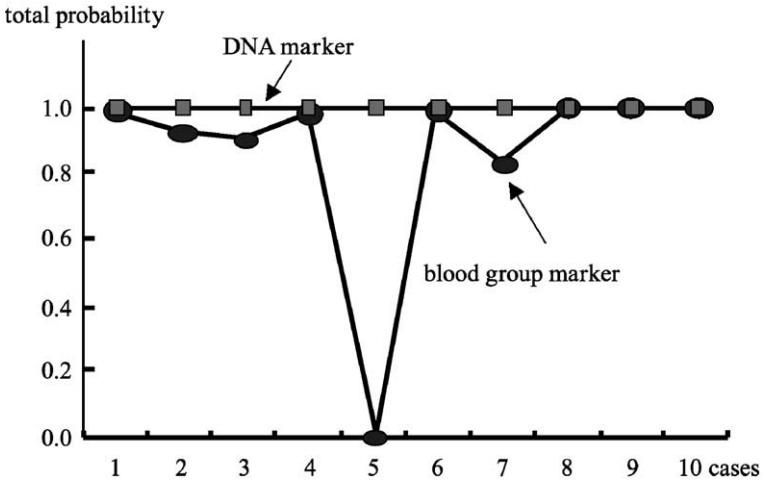

Fig. 3. Comparison of probability of paternity confirmation in 10 cases where the alleged father was deceased.

0.9973 and 0.7169 for 16 DNA polymorphic markers and 20 conventional blood group markers in five cases of half-sibling testing (Fig. 4).

4. Discussion

These results demonstrated that DNA polymorphic markers are an extremely effective method for paternity testing. Significantly high probabilities were obtained with DNA

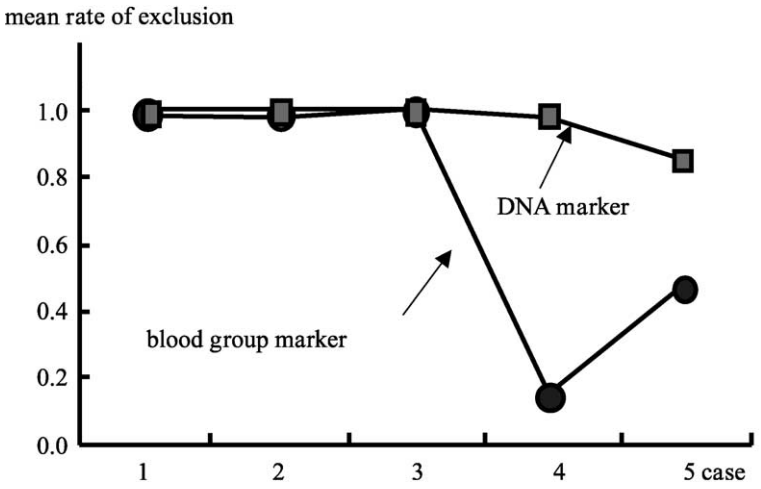

Fig. 4. The comparison of paternity probability in five cases of half-sibling testing.

polymorphic markers in these paternity cases. We are planning to examine more than 16 loci using DNA polymorphic markers in paternity testing.

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