Paternity Testing with an Absent Mother: The Probability of Exclusion of Red Cell Surface Antigen, Gm, Hp, and HLA Systems in North American Whites and Blacks

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INTRODUCTION

In some instances of questioned paternity, the laboratory may not have a blood sample from the mother. She may be unavailable because of death, mental illness, non-cooperativeness, intentional avoidance, or other problems. In such cases, the blood tests can still be used to either exclude the alleged father or derive a probability of paternity if there is a failure to exclude. This study was developed to examine the mean probability of exclusion ($\bar{A}$) of red cell surface antigen, Gm, Hp, and the HLA systems in North American whites and blacks in such cases.

METHODS

Paternity test cases completed between June, 1975 and April, 1987 were separated by the race of the adults into two groups - white and black. Mixed racial pairs and other racial groups were excluded from the study. The alleged father (AF) in each case was then moved forward one case in the sequence and re-assigned as the AF in the next mother(M)-child(C) combination in order to create false trios. The false trios were examined manually in duplicate to determine whether or not the AF could be excluded in any genetic system as the biological father of the child, either with or without including the phenotypes of the mother. Genetic markers identified included: ABO:A_1,A_2,B,O; MNSs:M,N,S,s: Rh:C,c,C^w,D,E,e; Fy:a,b; Jk:a,b;Gm:a,x,g,f,b; Hp:1,2; HLA:16A, 28B.

RESULTS

The observed $\bar{A}$ values with and without the mother for each system examined are displayed in Table 1.

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DISCUSSION

The results indicate that blood tests can be extremely useful in the exclusion of paternity using only the phenotypes of the AF and C. The most useful systems, depending on the race, were the HLA, Rh, Fy, MNSs, and Gm systems. The combined probability of exclusion (CPE) using these systems is approximately 90% for both races. The addition of more systems to the test panel can raise the CPE to over 92-95% depending upon the additional systems utilized. Clearly, the HLA system is very powerful in these tests and retains about 90% of the value obtained when the mother is included, in contrast to 12-70% for the other systems evaluated.

Formulas for estimating $\bar{A}$ of various blood group systems without testing the mother have been given by Lee, Lebeck and Pothiawala in 1980.[1] $\bar{A}$ values for 21 systems were calculated using gene frequencies of American whites. However, their report did not consider all of the potentially incompatible phenotypes of AF and C. In addition, only 5 HLA-A and 5 HLA-B markers were recognized in the HLA calculation.

Most of the $\bar{A}$ values derived in this study are in agreement with, or higher than those reported by Lee et al. More incompatible phenotypes were recognized in the Rh system and many more HLA A and B locus markers were identified in this study.

Whenever feasible, the mother's parents should be phenotyped since this additional information may, by itself, point toward an exclusion or alternatively, a higher PI. Blood tests of genetic markers of the alleged father and child can be very useful, even in the absence of the mother's specimen, in resolving cases of questioned paternity.

REFERENCE

1. Lee Cl, Lebeck L, Pothiawala M. Exclusion of paternity without testing the mother. Am J Clin Pathol 1980;74:809-12.

TABLE 1: Mean probability of exclusion ($\bar{A}$) for whites and blacks, with and without mother, for multiple genetic systems.

	Whites %(± SE 2)			Blacks %(± SE 3)		
System	n	With Mother	Without Mother	n	With Mother	Without Mother
*ABO	577	18	3	176	18	9
*MNSs	541	31	18	163	28	15
MN	571	19	12	172	22	14
*Rh	571	36	22	172	20	8
*Fy	538	26+	19+	161	16	2
*Jk	536	16	11	156	13	8
*Gm	468	26	12	116	22	13
*Hp	507	19	12	125	17	11
*HLA	585	93	85	174	93	84
*Combined Probability of Exclusion (CPE)		99	95		98	92

n=cases evaluated

+$\bar{A}$ values for Fy in whites slightly overestimate (1-2%) the exclusion probabilities due to the gene frequency of Fy which is approximately .0255 in this population. The resulting CPE values corrected for this variance are not affected.