

Application of DNA Fingerprinting to Problematical Paternity Cases

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INTRODUCTION

DNA fingerprinting has found wide application in forensic science practice. This communication describes briefly the results of DNA fingerprinting with minisatellite probes applied to problematical paternity cases with a relatively low probability of paternity or involving silent alleles.

MATERIALS AND METHODS

Typing for Conventional Genetic Systems

Blood samples from paternity trios were tested for 27 conventional genetic systems by routine techniques. The genetic systems used were as follows: 7 red cell antigen systems (ABO, MNS, RH, DI, P, JK, and FY); 14 serum protein systems (GM, KM, HP, TF, GC, PI, A2HS, C6, C7, C81, BF, HF, HI, and F13B); and 6 red cell enzyme systems (ACP, ESD, GPT, GL01, PGD, and PGM1).

Case Summary

In Case 1, blood samples were tested for 25 genetic systems, exclusive of GM and KM since the child was four months old. The overall probability of paternity exclusion by the 25 systems was 0.9563, yet none of the systems indicated nonpaternity. On the other hand, the overall probability of paternity was 0.4175, which was too low to establish paternity.

In Case 2, typing for 27 genetic systems revealed isolated nonmaternity in the GM system and nonpaternity in the C7 system. Contrary homozygosity was observed in both systems (GM AG/GM AB3ST and C7 1/C7 2). Based on the 25 systems, exclusive of GM and C7, the overall probability of paternity exclusion was calculated at 0.9990 and the overall probability of paternity at 0.9986, which was interpreted as establishing paternity. The results strongly suggested the presence of silent alleles in the GM and C7 systems. In addition, a GC variant with two pairs of double band was found in the mother; therefore, the blood samples of the mother's family were examined

likewise. Unfortunately, we could not examine the alleged father's kindred.

DNA Fingerprinting

DNA samples were isolated from peripheral blood by a phenol-alcohol method and digested with *Hae* III (Case 1) or *Hin* f I (Case 2). After agarose gel electrophoresis, the digests were Southern-blotted onto nylon membranes. The blots were hybridized with a digoxigenin-labeled MZ 1.3 probe (B.E.S.T.-Probe, Biotest, Frankfurt, FRG) in Case 1, and with an alkaline phosphatase-labeled synthetic Myo probe (SNAP Probe, Molecular Biosystems, San Diego, Ca) in Case 2. The band sharing frequencies were calculated according to the formula of Schacker *et al.* (1990).

RESULTS AND DISCUSSION

Figure 1 shows the DNA fingerprints. In Case 1 (left part), the numbers of shared child/mother and child/alleged father bands were 5 and 4, respectively. The band sharing frequency for the alleged father was calculated at 0.571, and this value was interpreted as establishing paternity.

In Case 2, the results of the family study supported the presence of a GM silent allele and a GC variant suggestive of a gene duplication of two *GC*1* alleles (Fig. 2). In DNA fingerprinting, the child shared 4 bands each with the mother and the alleged father (Fig. 1, right part). The band sharing frequencies were 0.500 and 0.615, which established parent-child relation.

This study demonstrates that conventional genetic systems cannot compete with highly polymorphic DNA loci.

REFERENCES

- Schacker U, Schneider PM, Holtkamp B, Bohnke E, Fimmers R, Sonneborn HH, Rittner C (1990) Isolation of the DNA minisatellite probe MZ 1.3 and its application to DNA 'fingerprinting' analysis. *Forens Sci Int* 44:209-224

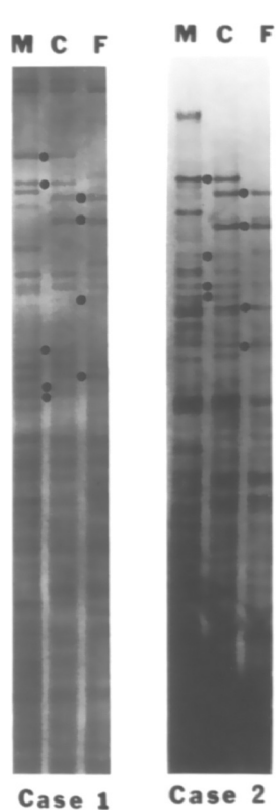


Fig. 1. DNA fingerprints of two families. M = mother, C = child, F = alleged father. Informative bands are indicated by dots

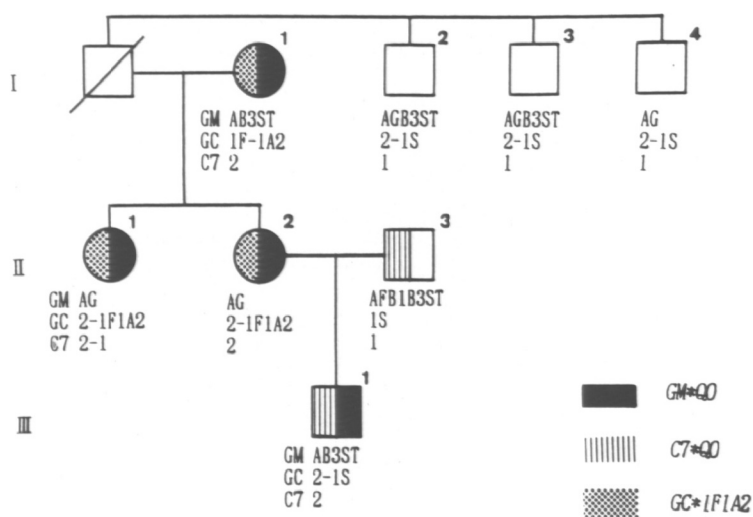


Fig. 2. Pedigree of the family with $GM*QO$, $C7*QO$, and $GC*1F1A2$ (Case 2)