



Short Communication

Investigation of paternity with alleged father deceased or missing: Analysis of success at the end of the report



Suelen Porto Basgalupp^{a,b}, Rodrigo Rodenbusch^{a,b}, Simone Schumacher^b,
André Zoratto Gastaldo^{a,b}, Deborah Soares Bispo Santos Silva^a, Clarice Sampaio Alho^{a,*}

^a Laboratório de Genética Humana e Molecular, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), 90619-900 Porto Alegre, RS, Brazil

^b Laboratório de Investigação de Paternidade, Centro de Desenvolvimento Científico e Tecnológico (CDCT), Fundação Estadual de Produção e Pesquisa em Saúde (FEPPS), 90610-000 Porto Alegre, RS, Brazil

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ABSTRACT

In this work we present a retrospective study of 858 cases of paternity investigation performed in Rio Grande do Sul, Southern Brazil, from 2007 to 2012, where the alleged father was deceased or missing. These cases represent 3.3% (858/26187) of paternity tests performed in that period. Considering the analysis of 17 DNA short tandem repeat *loci*, we present here the proportion of cases with conclusive results according to the number of relatives of the unavailable alleged father investigated and their kinship. The results show 81.0% (695/858) of cases with conclusive results and their characteristics.

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1. Introduction

In cases where the alleged father is deceased or missing (unavailable alleged father or UAF) the process of reconstructing his genetic profile is done by investigating DNA profiles from his closest relatives (first degree). Ideally, calculations about the UAF profile should be computed by simultaneous analysis of DNA from UAF's father and mother, i.e. both parents of the alleged father (pUAF). This setting of both pUAF profiles is the most informative for the UAF genetic profile reconstruction and will allow obtaining conclusive reports. However, if profiles from both pUAF are not available, the alternative method to obtain conclusive results is to analyze other UAF's relatives. In theory, analyzing a higher number of UAF's close relatives and a greater number of DNA regions increase the chances to have better success on the conclusive reports [1,2]. Indeed, some works have been published with theoretical studies on this subject considering different number of relatives and how efficient is pairwise kinship analyses in different scenarios [3,4]. However, until now no studies related data about the number and/or kind of UAF relatives who are required to

investigate and to have a conclusive final report. Despite the importance to forensic application, there is a lack of studies reporting data or criteria to select the UAF relatives to be investigated and to successfully conclude the complex cases with unavailable alleged father.

In this paper we present a retrospective study of 858 cases of paternity investigation performed in Rio Grande do Sul, Southern Brazil, from 2007 to 2012, where the alleged father was deceased or missing. These cases represent 3.3% (858/26,187) of paternity tests we performed in that period. All participants signed the informed consent.

2. Methods

The genetic profiles were obtained by amplification of 17 DNA regions (*loci* TH01, TPOX, CSF1PO, vWA, D3S1358, FGA, D5S818, D13S317, D7S820, D8S1179, D16S539, D18S51, D21S11, D2S1338, D19S433, Penta E and Penta D) using AmpF/STR[®] Identifier[®] PCR Amplification Kit (Life Technologies Corporation) and Powerplex[®] 16 System (Promega Corporation), and were analyzed using ABI 3130xl Genetic Analyzer (Applied Biosystems, Foster City, CA, USA) capillary electrophoresis instrument. The designation of alleles and the quality control of results were performed using GeneMapper, software version 3.2 (Applied Biosystems, Foster City, CA, USA). Our laboratory participated in the GEP/ISFG Collaborative Study.

* Corresponding author at: Laboratory of Molecular and Human Genetics, Faculty of Biosciences, PUCRS, Av. Ipiranga 6681, 90619-900 Porto Alegre, RS, Brazil. Tel.: +55 51 3320 3568; fax: +55 51 3320 3568.

E-mail address: csalho@pucrs.br (C.S. Alho).

A survey of cases with the UAF and several familiar conjunctures was done. According to the data presented in the Annual Report Summary for Testing in 2008 (AABB), our group considered as conclusive the reports that presented a Combined Paternity Index (CPI) equal or higher than 1.000 (99.9% probability of paternity) [5]. The software used to compute the statistics for CPI was FAMILIAS version 1.81 [6].

3. Results and discussions

A total of 858 cases with UAF were evaluated. A large number of cases (28.2%; 242/858) lead to calculations performed by simultaneous analysis of DNA from both pUAF profiles; for all of these cases this configuration allowed a success conclusion rate at the final report (Table 1). The remaining cases were divided into five categories, considering only the level of kinship of the individual to the UAF. The complementary categories were: (2) one pUAF plus UAF's full-siblings (sUAF); (3) sUAF; (4) UAF's child (legal son or legal daughter) (cUAF) plus his/her mother (mcUAF); (5) cUAF; (6) only one pUAF. All these categories were examined considering the number of related individuals. In all cases, there were also the proband child (son or daughter whose paternity wanted to be tested) and his/her mother.

The results showed that excluding the configuration of both pUAF available (category 1), the highest success rates to obtain the UAF profile and the conclusion of a final report were obtained with the configurations of three cUAF + mcUAF (99.0%) and of one pUAF + three sUAF (93.3%) – as shown on Table 1. The lowest rates were observed in configurations of one sUAF (10.0%) and only one pUAF (17.4%); since these two configurations (full-siblings or parent–child) mathematically have the same genetic component

Table 1

Cases of paternity dispute with alleged father deceased or missing (Rio Grande do Sul, Brazil, from 2007 to 2012).

| Categories | Total N | Conclusive N | Success rate % |
|---------------------|------------|-----------------|-------------------|
| (1) Both pUAF | 242 | 242 | 100 |
| (2) One pUAF + sUAF | 118 | 92 | 78.0 |
| One pUAF + 3 sUAF | 45 | 42 | 93.3 |
| One pUAF + 2 sUAF | 42 | 35 | 83.3 |
| One pUAF + 1 sUAF | 31 | 15 | 48.4 |
| (3) sUAF | 76 | 46 | 60.5 |
| 4 sUAF | 17 | 15 | 88.2 |
| 3 sUAF | 20 | 16 | 80.0 |
| 2 sUAF | 19 | 13 | 68.4 |
| 1 sUAF | 20 | 2 | 10.0 |
| (4) cUAF + mcUAF | 250 | 216 | 86.4 |
| 3 cUAF + mcUAF | 99 | 98 | 99.0 |
| 2 cUAF + mcUAF | 113 | 104 | 92.0 |
| 1 cUAF + mcUAF | 38 | 14 | 36.8 |
| (5) cUAF | 172 | 99 | 57.6 |
| 4 cUAF | 28 | 22 | 78.6 |
| 3 cUAF | 31 | 26 | 83.9 |
| 2 cUAF | 38 | 31 | 81.6 |
| 1 cUAF | 29 | 12 | 41.4 |
| (6) One pUAF | 46 | 8 | 17.4 |
| Total | 858 | 695 | 81.0 |

UAF, unavailable alleged father; pUAF, UAF's parent; cUAF, UAF's child; mcUAF, mother of UAF's children; sUAF, UAF's full-sibling.

(around 50% of shared DNA) [7] the higher percentage of the last configuration is likely due to sampling effect.

A point to be considered is that the alleged kinship to the UAF was based on verbal report (declared relationships) of the subjects investigated. In paternity cases, there is a chance that a kinship reported as true might not be a real biological one, and in a laboratory that performs thousands of investigations, the number of this kind of situations can be substantial. It is also important to highlight that our data refer to the analysis of the worldwide most used 17 *loci*; for this set of markers the results showed 19.0% (163/858) of inconclusive cases. When the cases were re-analyzed using different systems in addition to the 17 *loci*, some cases turned to conclusive and the total percentage of inconclusive cases declined. But even with additional markers, cases with only a few UAF's relatives remained without conclusion. So, despite of other autosomal, sexual or mitochondrial chromosome analyses, it could be more effective genotyping one or two additional UAF relatives to obtain a better rate of conclusive reports. In this same topic, according to Nothnagel et al. [4], it could be more economic to genotype one or two additional individuals, if available, rather than to rise the genotyping load.

Our results confirmed that, in fact, the higher the number of UAF close relatives analyzed the greater is the success rate of conclusive final reports. In these instances, the priority should be strengthened to the inclusion of more close biological relatives to the UAF in cases where the alleged father is deceased or missing. The inclusion of only one or distant UAF's relative, when there are no other options, can result in a low probability of a conclusive report. Every requested paternity process not only triggers emotional distress to individuals and families, but also demands administrative efforts, commitment of skilled professionals and high financial costs. Cases with unavailable alleged father are complex and a process that generates inconclusive results leads to the loss of all these efforts and investments.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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