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Paternity Testing In Nigeria: Evolutionary Trends, Current Status and Challenges in a Low Resource Economy

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----------***ABSTRACT***----------

Paternity testing in Nigeria is not a new phenomenon. Over the years, there have been controversies surrounding the paternity of children in our society which has further substantiated the need for accurate testing to establish the paternity of children in many circumstances. This study examined paternity testing in Nigeria, its evolutionary trends, current status and challenges. The study was a reviewed literature in which data was sourced from reputable publications related to the study. The study explored the evolutionary trend of paternity testing in Nigeria prior to the advent of the current DNA testing such as the blood group antigen and the serological testing. Some of the challenges identified in the study confronting paternity testing in Nigeria include lack of human capacity, poor funding and ill-equipped laboratories that can only offer ABO/genotype screening services which may result to inaccurate paternity results among others. As a result, this has led to various discrepancies in paternity results.

Keywords: *Paternity, DNA testing, ABO genotype, Serological testing*

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I. INTRODUCTION

Paternity testing can be defined as an assessment of possible paternity based on a comparison of the genetic markers of the offspring and those of the putative father. Paternity testing can also be defined as the use of genetic fingerprinting to decide the biological parent-child relationship between two individuals [1]

Human identification has not always been conclusive. Prior to the advent of the use of Deoxyribonucleic acid (DNA) for paternity testing, the scientific community used other biological techniques for identification of people and to determine biological relationships. In the 1920s and 30s, people become fascinated with the idea that paternity was a biological truth science could uncover However, many of the earliest paternity test seems outrageous today. A device known as oscillophore was invented by Albert Abrams which is used to determine paternity by measuring vibrations of the blood .Others related shape of ears or even disinterred dead bodies to establish a correlation. Also, in 1940s, Brazilian dentist Luiz Silva analyzed teeth, jaw and facial features to determine paternity. However, since the 1990s, the more common approach has been to consider the presence of particular genotypic markers when attempting to establish fatherhood (and in a handful of cases, motherhood) [2]

Most of the questions relating to paternity are not so easy to answer. For decades, they have posed a major challenge to scientists and potential parents. There are cases which concrete and scientific evidence of parentage are demanded for. Paternity test may be demanded by either the physician or a court order, immigration authorities, government child support agencies or welfare benefits.

PURPOSE OF PATERNITY TESTING

Paternity testing is done for various purposes which includes;

1. To obtain child support
2. To foster peace of mind for all involved parties
3. To determine the biological father or the biological mother
4. It is an important tool in proving immigration status in cases of family reunification
5. To establish accurate medical history of the child.

THE EVOLUTION OF PATERNITY TESTING TECHNIQUES

Over the past decades, several techniques have evolved for paternity testing. This has led to improvement in the accuracy of results for the test. Techniques used for testing includes;

- BLOOD GROUP ANTIGEN (ABO TYPING)
- SEROLOGICAL TESTING
- DNA TESTING

BLOOD GROUP ANTIGEN

The most common method used for paternity test before the invention of DNA testing was the use of blood group antigen. This technique was presented to paternity investigation after the invention of Mendelian inheritance of the ABO blood group system by von Dungern and Hirschfeld in 1910 [3,4]. In 1920, the first ABO testing for paternity testing was done in Europe and states like New York and Wisconsin adopted the technique in 1935 [5]

This test is based on the inheritance of blood types from one generation to another and its majorly used to disprove paternity [6]. The scientific basis for blood testing in disputed paternity cases lies on the principles of Mendelian genetics. Large number of distinguishable genetic markers are present in the blood which have specific inheritance patterns. These genetic markers are inherited by the children in pairs one from each parent [7]. The blood group antigen system that are of greatest importance includes ABO, Rh, MNSs, Kell, Duffy and Kidd. Each of the system produces a high level of exclusion in relation to cost of analysis. The antisera required for testing are reliable and readily available [8].

The ABO gene is located on the long arm of human chromosome 9 and consist of 7 exons [9]. The A and B are co-dominant while the O is recessive. Two A alleles or one A allele and one O allele has been known to be inherited by someone with blood group A, also a person with blood group B inherited either two B alleles or one B allele and one O allele and a person with blood group AB will inherit one A allele and one B allele. This knowledge has been used for exclusion of a man from being a child's father in which a man with blood group AB would only pass to his offspring either the A or the B allele and not the O allele [10]

Steps that are involved in the use of blood group antigen for paternity testing includes;

- Identification of the people concern and recording of their ethnic origin
- Ensure that samples are taken from the people in the paternity suit
- Correct investigation should be carried out on blood samples and results checked
- Analysis of data
- Present either proof of exclusion a probability of paternity
- Reports should be presented to lawyers which shows the importance of the laboratory results [11]

SEROLOGICAL TESTING

In the mid-1970s, scientists focused on tissue typing and discovered the Human Leukocyte Antigen (HLA), a protein present in the body except for the red cells. White cells found in blood were determined to have a high concentration of HLA. There are four types of HLAs: HLA-A, HLA-B, HLA-C and HLA-D [12]. The different types of HLA varied between people who were not biologically related. Because of the high variability of HLA types among people, HLA was used to answer about biological relationships. The power for exclusion for HLA testing is 80%. When coupled with ABO and serological testing, it's about 90% [13]. The HLA helps in provision of evidence of tissue compatibility typing of tissue recipients and donors. It also aids in genetic counselling and in paternity testing. It also plays an important role in the body's immune response. Because the HLAs are essential to immunity, identification aids in determination of the degree of tissue compatibility between transplant recipients and donors [12].

HLA types can be shared with close relatives which is majorly seen in cases of organ transplant like kidney where a donor with the same HLA type mostly a close relative will be needed for the transplant [6]. This will pose a difficulty in ruling out father of two or more brothers with same HLA type as it cannot differentiate between related alleged fathers. The HLA testing in paternity determination is to identify specific leukocyte antigens, HLA-A, HLA-B, HLA-C and HLA-D [14].

DNA TESTING

Alec Jeffreys, a professor of Genetics at University of Leciester developed the process of DNA fingerprinting in 1984 and it was later adopted as use for paternity testing in 1988 [15,16]

Nowadays, DNA testing is the most common testing done to determine paternity. The process of DNA testing for paternity involves five steps which includes sample collection, DNA extraction, quantification, amplification and STR analysis. DNA is extracted from biological source in the sample collection stage which is measured to analyse the amount of DNA recovered in quantitation step. Amplification stage involves the target and copying of specific regions of DNA with polymerase chain reaction. Use of commercial kits to enable simultaneous PCR of 13 to 16 STR markers occur in the final step which is the Short Tandem Repeat (STR) analysis step [17].

DNA QUANTITATION USING RT-PCR

This technique is required mainly to ensure that DNA recovered from extraction is from human rather from other source such as bacteria [18]. Isolation of DNA sample ensures the assessment of its quantity and quality [19]. The main aim of DNA quantitation in paternity cases is to detect the suitable quantity of DNA template to use in PCR amplification of short tandem repeat loci to avoid off scale data and related objects [20]. Overblown electropherograms which affects interpretation of results occurs in PCR amplification of too much DNA results whereas too little DNA result can lead to loss of alleles due to random amplification and failure for equal sampling of the STR alleles present in the sample [21]. The various DNA quantitation tests are used in approaches such as yield gels, Pico Green, end-point PCR, real-time quantitative PCR, UV absorbance, and slot blot. The most common method used to determine DNA harvest and clarity is UV absorbance. Two major approaches are used in DNA quantitation which are the fluorogenic 5' nuclease assay known as TaqMan or intercalating dye such as SYBER Green [21].

PCR AMPLIFICATION

Polymerase chain reaction, an enzymatic process which involves the replication of specific region of DNA repeatedly to produce many copies of a particular sequence which are defined by oligonucleotide primers complementary to the 39-ends of the sequence of interest. Inhibition of PCR or poor primer annealing could contribute to reduction in amplification efficiency leading to low PCR products [22].

The use of PCR technology has improved DNA testing, some of which includes the amplification of small quantity of DNA to increase the amount of DNA up to a billon copies of same DNA used for analysis. Also, use of PCR technology ensures easy and fast performance of several DNA relationship tests. Buccal swab specimens are used in a standard DNA parternity test today and are usually collected from the tested party in a non-invasive manner although paternity can be determined before the child is born via the use of amniotic fluid which contains the embryo's DNA [17].

Various precautions should be carried out during this test to ensure accuracy of results, they include the use of aerosol-resistant pipette tips to prevent cross contamination during liquid transfers, laminar flow hood should be used for reactions to prevent contamination, use of disposable gloves should be encouraged, equipment such as pipettes and reagents for sitting up PCR should be kept separate from other equipment in the laboratory, PCR amplification reactions should be carried out in a separate containment cabinet [17].

DNA TESTING WITH RLFP

Restriction fragment length polymorphism (RFLP) which was introduced in 1980 is a technique used to exploit variations in homologous DNA sequences known as polymorphism in order to distinguish individuals or for location of genes within a sequence [23].

In this test, DNA is cut into specific fragments with the use of restriction enzymes. Use of special gel with an electric charge separates these fragments by sizes which the longer ones are removed due to inability to move fast through the gel as short fragments. The short fragments are usually compared to check for similarities in their patterns. Half of the mother's DNA fragments and half of father's DNA fragments will match the child's DNA fragments. Accuracy of this test was placed at 99.99% [24,25].

CHALLENGES

Nigeria as a whole cannot be excluded from prevailing global paternity dispute or fraud. However, the laboratories in the country are poorly equipped and may only provide ABO/genotype screening services which are prone to inconclusive paternity results. The analysis of DNA polymorphism which gives a closely accurate result is not commonly practiced in tertiary hospital in Nigeria including University of Medical Sciences Teaching Hospital, Ondo due to various challenges which includes lack of human resources, lack of financial support, lack of facilities, and low expertise in the country. This leads to the majority of the private diagnostic

centres in the country sending samples out of the country for processing which will take a longer period before the results are sent back to the country.

Also in Nigeria, no law has been made on the accreditation of the paternity testing laboratories. Accreditation will ensure legitimacy and reliability of the individual's paternity test and lack of this has a major side effects on the result of the test parties and the few paternity testing laboratories in the country serves as collection centres for accredited laboratories in developed countries. [26]

Paternity testing practices in the country are still unregulated and the only practice carried out involves collection of DNA samples using test kits and sending outside the country for laboratory analysis [27]. Unavailability of accrediting agencies to oversee this process may sometime lead to quality assurance issues.

II. CONCLUSION AND RECOMMENDATIONS

In conclusion, various factors contribute to paternity discrepancy in the nation, with this influencing the outlook of the general society on paternity test as a reliable test.

However, this situation can be arrested by improving accuracy of results gotten during paternity testing. Therefore, we recommend the following actions:

1. Training of staffs on the procedures for the paternity testing will help improve result accuracy as well as provide more manpower in the country.
2. Financial support should be provided by the Nigerian government through the Central Bank of Nigeria (CBN) by reducing the interest rates on loans to single digits to further encourage all health institutions in carrying out this test within Nigeria.
3. More Infrastructures for carrying out this analysis should be provided by the Government and private institutions in all geo-political zones in the country.
4. More Institutional collaborations with centers outside the country should be encouraged.
5. All higher Institutions should be encouraged and supported by either governmental, or private entities to have a molecular and diagnostic laboratory of high standard to improve the health industry.
6. Tested parties must be properly identified and specimens should be collected by a third party professional with no relationship with tested parties and no interest in outcome of the test

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